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DR A. RITTER

CARLSBAD

AND ITS SPRINGS, A CLINICAL STUDY

A PRIZE ESSAY

PUBLISHED BY THE TOWN COUNCIL OF CARLSBAD

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CARLSBAD

CLINICAL STUDIES

ON THE

MODES OF ACTION, INDICATIONS FOR THE USE AND CURATIVE VALUE OF ITS MINERAL SPRINGS

BY

DR. ADOLF RITTER

MEDICAL COUNCILLOR TO THE GRAND-DUKE OF OLDENBURG
PHYSICIAN IN CARLSBAD

PRIZE ESSAY

(TRANSLATED FROM THE GERMAN)

CARLSBAD
EDITED BY THE TOWN COUNCIL OF CARLSBAD
1910

Stiepel Brothers, printing works, Reichenberg, Bohemia.

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PREFACE.

The present treatise is intended to meet the long felt want of promoting in wider medical circles a knowledge of Carlsbad and all that can be said about the mode of action and application of its springs from the modern scientific point of view. The constantly repeated requests from these circles for an instructive treatise in accordance with the modern ideas on matters relating to our cures lead to the assumption that there is an actual demand for such a treatise. In order to meet this demand the Town Council of Carlsbad in April 1907 invited the physicians of the town to take part in a prize competition, and by a specially instituted prize-committee the principles were worked out in the form of a programm, on which the treatise should be based. As the last day for the delivery of the work the 1st November 1907 was fixed.

On the 13th of February 1908 the meeting of the committee took place; to this committee belonged Dr. Pfeifer, the mayor, Dr. Becher, Dr. Fink, Dr. Hirsch, Leo Edler v. Mattoni, and Dr. Pleschner. As officiating judges, Privy Councillor Prof. Dr. Rudolf Jaksch, Ritter v. Wartenhorst, and Prof. Dr. Karl v. Noorden presented their written decision. The first prize of 2000 Kronen (about £ 85) was awarded the present treatise; at the request of the author this amount was devoted to charitable purposes.

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With sincere thanks the kind and unselfish cooperation of Dr. S. Buxbaum must be acknowledged, who owing to the pressure of the time most obligingly undertook the compilation of several chapters. and thus rendered possible the completion of the work by the date fixed.

I also desire to take this opportunity of conveying warmest thanks to Dr. phil. Charles Curry in Munich for a final revision of the proof sheets.

Carlsbad 1909.

Dr. Ritter.

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CHAPTER I.

The Climatic, Meteorological, and Hygienic Conditions of Carlsbad.

Carlsbad lies in one of the most delightful valleys of the Austro-Hungarian Monarchy, which is so well known for its numberless natural beauties. Through part of this valley the river Tepl flows in sharp windings. In the dry season it contains hardly more water than a brook, but after constant rains or cloud-bursts it rages through the peaceful valley like a wild torrent which only the massive rocks of granite seem able to defy. Originally these extended quite close up to the river, which has slowly cut out its own bed in the rocks. This valley, so favoured by Nature, does not possess any two points similar to each other. Every-where it is like a marvellous Cathedral, whose walls come straight down from the thickly wooded heights, and it contains one of the most wonderful natural sights — for it is the source of our hot spring, the Sprudel! Here the first visitors must have been more enraptured by Nature's power than people of our time who look at the valley, our hot spring town of to-day. In a technical way man has accomplished here marvels but Nature had to be violated. Step by step ground for the erection of buildings had to be won from the wild stream and surrounding rocks. Many things, that should have been avoided,

in order to preserve the charms of the town, were done as the rapid growth ot this health resort compelled the inhabitants to build new houses. In consequence of the numerous windings of the valley, which actually give one the impression of being shut in in all directions, the climate of Carlsbad is milder than that of the immediate neighbourhood. It differs, in fact, not much from that of Central Europe.

The temperature in midsummer is 76°, and the mean barometric reading 29 inches. As a rule the winter brings several heavy snowfalls, and is moreover severe, owing to the neighbourhood of the Erzgebirge („Brass Mts.") Generally speaking the autumn is fine until far into November, severe storms being extremely rarely experienced. Due to the neighbourhood of the extensive old forests there is sufficient rain; but, generally speaking, long periods of rain are only observed in the late autumn and early in spring.

The best hygienic conditions also prevail. Here we find everything that lies within human power for maintaining the conditions of health of a town at the highest level, in spite of the enormous technical difficulties encountered. Carlsbad possesses an aqueduct with the most modern form of filtration for water for technical purposes (irrigation etc.). It has a system of aqueducts for drinking water, whose modern extension has for a long time had the special attention of the Town Council. Carlsbad possesses also a drainage system, fulfilling the most subtile requirements, which in consequence of the very great difference in the level of the houses and the fact that its terminal point is bound to be at the lowest level of the Eger, forms an engineering work of great merit. The drainage pipes had to be embedded in the narrow streets close to a network of pipes.

The town possesses all hygienic arrangements. Besides a perfectly modern hospital built on the pavilion system, which is used chiefly by the native population, there is also a series of establishments, which are

at the disposal of the healthseeking public. These are referred to in the chapter on the Cure itself. To the hygienic institutions belong also the lighting works of the town, i. e the gas and electricity works, which supply Carlsbad most profusely with light. Great attention is devoted to the inspection and control of provisions in Carlsbad due to the great importance of all matters relating to food in our health resort. The supervision of the supply of meat extends not only to the slaughter-house, but also to all meats and provisions, including meats which are imported into Carlsbad, even if they have been examined before having been brought into the town. This supervision is rendered easy by the fact that the slaughter-house in Carlsbad is furnished with all modern apparatus and auxiliary installations; it is also provided with a special cooling plant. Nor is the milk supply less strictly regulated. The control is not limited to the provisiondealers only, but extends also to the hotels, and the delicacy shops. The supervision is exercised by the Market Office, an office specially established for this purpose; and this system has given the best results with regard to the education of the population as to the observance of the hygienic conditions relating to food.

The care of the public sanitation is in the hands of a medical town official and two town doctors. The health conditions of the town may be stated to be excellent in spite of the fact that its inhibitants are living closely together, and in spite of the great influx of people from countries, where the public health department is regarded with horror and where its function is at the best of a temporary nature. Carlsbad has remained absolutely free from great epidemics during the last decade, while infectious deseases introduced from abroad could be limited to single cases.

CHAPTER II.

The Cure and Remedies of Carlsbad.

1. Springs.

To the most important means of cure at Carlsbad belong its springs and above all the dominating Sprudel. To it alone Carlsbad owes its importance as a health resort. The slight differences in the chemical composition are readily accounted for by the difference in the composition of the rocks, through which the different springs find their way from the interior of the earth to the surface.

The Sprudel gushes out of the so-called "Sprudel-cup", a cover deposited by the thermal water itself, which forms the protecting roof for a series of natural chambers, communicating with each other and filled with gas, and which tends to regulate the pressure of the gas within. It has, in fact, frequently happened in the course of centuries that the excessive gaspressure has burst this cover, viz the "Sprudel-cup", so that the hot water has streamed out through the new opening in enormous quantities; in consequence of which the "Springer", or opening, through which the water usually gushes, has dried up. The cause of this occurrence is to be found in the petrification of the original opening, which upon growing constantly narrower, brings about an increase of pressure in the underground gas chambers. In order to prevent such violent eruptions the discharging holes of the Sprudel are rebored from time to time. At present there are six such openings or borings all of which lie close to each other. The quantity of water discharged by these is very considerable (borings V and VI for instance yield 1388 litres per minute); this water is conducted through a series of pipes, which lie under the pavement of the Sprudel colonnade, to the

bathing establishments and Sprudel salt works. The springs of boring II yield about 48,6 litres per minute. There is nobody observing this wonderful spectacle for the first time, who would not be deeply impressed by this fascinating sight. We do not intend to discuss at present the chemical composition either of the Sprudel or of the thermal springs of Carlsbad. These will be referred to specially in the subsequent pages. We only observe that it was Dr. David Becher, one of Carlsbad's best patriots, who in 1770 made the first chemical analysis, which is still recognized. To the Sprudel belong also the old and new Hygeia Springs. The former was bored in 1811, and was originally 12 metres high. It is now only used for enriching the Sprudel salt with carbonic acid gas. It should also be mentioned, that the temperatures of the springs, which have been recorded for the last 150 years, have practically not varied throughout that period. The total yield of all the Sprudel springs, moreover, shews no appreciable diminution when compared with those of former times.

The Schlossbrunn.

This spring has been known since 1784. It was the highest situated, and at that time the coolest spring; its temperature was 50° C. In the course of years the spring repeatedly dried up, the first time as direct consequence of the mighty Sprudel outburst of 1809. In 1823, however, the Schlossbrunn reappeared as a rich spring. The same thing frequently recurred during the last century; this necessitated deep borings and new linings, since apparently the gas pressure had repeatedly been falling. In 1906 the Spring nearly dried up again. After extensive searches the vein of the spring was found again in 1907 somewhat below the "Quelltempel", a fresh boring yielding about 10,785 litres per minute at a temperature of about 44,7° C.

In the immediate neighbourhood of the Schlossbrunn lies the "Russian Kronenquelle", which is not used for drinking purposes.

The Marktbrunn.

The Marktbrunn was discovered in 1838, and after having been lined was used for drinking purposes. The yield of this spring, whose source was a stalactite formation at the foot of the Schloss Mountains, was somewhat variable, so that repeated borings and fresh linings had to be made, which were successful. This spring consists of a number of smaller ones, which were combined in 1879. The present yield is 8,845 litres per minute, the temperature 46,3° C.

The Kaiser Karl Spring.

This spring has been used for drinking purposes since 1871. It is told, however, that on its place at the times of Emperor Charles VIth there existed already a pool of spring-water, in which the Emperor bathed his diseased foot. The spring only yields 0,805 litre of hot water per minute, which has a temperature of 30,5° C.

The Mühlbrunn.

This well was known in the sixteenth century. It was lined for the first time in 1777. Its yield is 8,304 litres per minute at a temperature of 47,1° C. It is, next to the Sprudel itself, the best known of the hot springs.

The Neubrunn.

This well was lined for the first time in 1746. Its yield, which in the last century was still of considerable importance, has now fallen to 1,009 litres per minute. Its temperature is 42° C.

The Bernhardsbrunn.

This broke out of a sinter-hill in 1784. Upon enlarging the opening a spring was revealed, whose yield equalled that of the Sprudel. In 1847 the spring still yielded 25 litres per minute, but its yield has decreased continually. In 1906 borings and linings of the ground

raised the yield to 6,682 litres per minute. The temperature of the water is 62° C.

The Theresienbrunn

was already known in the sixteenth century, and was lined for the first time in 1763. Fluctuations in the discharge occurred here too, so that the new secondary openings which formed had to be stopped up and reborings had to be repeatedly made. At the time of the erection of the Mühlbrunn colonnade the spring was lined once more and yielded an abundant supply of water, part of which in 1881 was conducted to the site of the Town Park and formed there the Park Spring. Its yield is 1102 litres per minute, and its temperature 41,7° C.

The Elisabeth Spring

is a combination of several small springs in the Mühlbrunn colonnade. It gives 2,249 litres per minute at a temperature of 30,5° C.

The Felsen Spring,

formerly known as Stephansbrunn, was lined in 1845. Its present yield is 3,493 litres per minute, its temperature 52,4° C.

The Franz Josef Spring

was formerly called the Kurhaus spring. It was discovered upon the erection of the Kurhaus in 1865. With a temperature of 59,6° C, it is the hotest of the small springs, and yields 6,170 litres per minute.

The Spital Spring.

This spring is situated behind the old Strangers' Hospital, which is now used as one of the town official buildings. It has been known since the sixteenth century. It is not used for drinking, and is, therefore, not lined. Upon the demolition of the old buildings the spring will probably be lined, and would then form a valuable addition to the spring treasures. It yields 3.572 litres per minute, its temperature being 29,5° C.

The Kaiserbrunn

was discovered during the building of the Military Kurhaus in 1851. It yields 3,353 litres per minute, and has a temperature of 43,7° C.

The Eisen Spring

yields 10,286 litres per minute, and has a temperature of 7° C.

The data on temperature and yield of the springs are based upon the official observations of the Municipality made on the 15th of Mai 1908.

2. Bathing Establishments.

For centuries past the thermal springs of Carlsbad have been used for bathing purposes. In fact the cure originally consisted in a more or less prolonged series of baths. Since 1836 the mud bath has been added to the number of different treatments at Carlsbad. During the last years the forms of treatment have increased to such an extent, that we can confidently say, that our health resort offers every modern form of treatment. Besides the Sprudel and mud baths, there are carbonic acid baths and Fango applications, complete and partial electric baths as well as light baths, steam and hot air baths, cold water treatment — in short all the modern methods of bathing.

The Sprudel Hydro.

This establishment owes its present form to a reconstruction made in 1878. It contains in two stories 32 Sprudel baths equipped with every modern convenience. The baths receive the Sprudel water from an elevated tank situated 10 metres above the floor of the Sprudel colonnade. It is transmitted thither by means of pumps. On every floor there is a waiting-room.

The Kurhaus.

This is an extensive, unadorned building. It was opened in 1867, and in the course of years frequent

changes have been made in its internal arrangements. It contains on the ground floor 50 comfortably furnished mud-bathapartments, as well as suitable waiting rooms. Here there is also a large machinery room as well as the mud storage and mixing rooms. In the upper ground floor is a modernly furnished gentlemen's steam bath, as well as a ladies' steam bath, besides 53 very well furnished Sprudel bathing apartments. On the first floor there are eleven rooms for artificial carbonic acid baths as well as a great number of chambers for the application of partial mud-baths and compresses. A greater part of the building is used for concert, reading, dancing and coffeerooms. On the second floor there are also some rooms for the application of mud-compresses.

The Neubad.

This bathing establishment exists since 1880. It is furnished very superiorly. It contains 24 mud-bath apartments on the ground floor and just as many mineral-bath chambers on the first floor.

The Kaiserbad

was opened in the year 1895. It is a building, which was erected with a view of special splendour and at great expense, practical conveniences often being sacrificed for internal decoration. The visitor is struck with the richly decorated vestibule, the magnificent staircase adorned with frescoes by the painter Jakesch, and the high studied and light corridors. The bath-rooms are arranged in a semicircle and all open upon a broard common corridor. On the ground floor are situated 27 such bathrooms aside from the Prince's room, which is so called on account of its exceptionally elegant equipment. Every bathroom consists of a dressing-room and bathroom proper situated towards the yard. These were furnished at the time of their erection with all the most modern requirements.

On the first floor is situated the institute for Swedish gymnastics according to the Zander system. It is one

of the finest of its kind and under the supervision of a specialist. Here there are also 25 mud bathrooms. On the second floor there are 14 mineral and 12 carbonic acid baths and the hot air rooms.

On the lower ground floor is the cold-water cure department with separate divisions for ladies and gentlemen, in addition to electric baths, steam baths, and a number of single rooms for cold water treatment. On every floor there are large waiting rooms.

The Elisabethbad.

This is the newest bathing establishment in Carlsbad, and was built in the year 1905—06 according to the plans of the Municipal superintendant of works, Drobny. It is an impressive structure, in the Biedermeier style. For its interior arrangements all the technical achievements of latest years have been made use of, and it possesses an extraordinary practical equipment. The building is one of three stories with 42 mud-bath-rooms, 29 Sprudel rooms, 15 carbonic acid baths, 24 chambers for mud-compresses and three for partial mudbaths. Besides a cold water establishment for gentlemen with 18 dressing rooms, it contains one for ladies with 10 such rooms, a few rooms for partial cold-water treatment as well as suitable waiting rooms. Special rooms are reserved for the machinery, which serves not only for the central heating, ventilation and cooling, but also for driving the elevators, by means of which the mudbaths are conveyed up and down.

Besides the above mentioned bathing establishments we have to refer to two small ones, the iron-baths and the bathing establishment above the Stephanie spring, which are not under the management of the municipal authorities.

An extremely beneficent institution is the Strangers' Hospital, a new building opened in 1892. This building is for the exclusive use of health-seeking persons not residing in Carlsbad. Above 400 persons can be

treated there annually. There are three classes, and even for the most modest means the cure in Carlsbad is rendered possible in consequence of the small payment demanded of the third class; while for poor people a number of free places are granted annually by the town council.

For members of the Royal Austrian army, who require the cure in Carlsbad, the Royal Military Hospital offers a very comfortable residence. The Military Hospital of the White Cross, which was opened in 1897, serves a similar purpose.

The Emperor Franz Josef's Jubilee Hospice for poor Jews affords its wards board and lodging free of charge.

In addition to the above institutions for the prosperous cure means of Carlsbad we have to consider a number of private enterprises, which belong to a health resort like Carlsbad. Their names are as follows:

The dietetic establishment of Dr. A. Ritter with 24 rooms. The house "Villa Ritter" is situated in the West end, and is intended for such persons requiring the cure, who wish to be under special medical supervision or to have a diet carried out under medical directions.

For special methods of treatment there exist a number of medical institutions. Besides the medico-mechanical establishment in the Kaiserbad there are the inhalatorium of Dr. Müller, that of Dr. Löwy, the institute for electrotherapy and x-ray treatment of Dr. Buxbaum, and the institute of Dr. Sachs for hot air treatment.

CHAPTER III.

The Importance of the Salts for the Organism in General.

If in the following an attempt is made to put the use of the Carlsbad mineral waters (and the Carlsbad "cure" generally) on a scientific basis, to offer a scientific interpretation for the same and consequently to render the indications for the use of the waters more easily understood, it must be stated at once that the best that can be offered in support of our views is a well founded empiricism. This is all that we are able to offer to-day in support of our views. However, this empiricism is a century old. It has matured in the traditional accounts of the art of the use of mineral springs, and always possesses that advantage over the best explanations for their mode of action that these explanations leave something missing, which medical experience only can bridge over. In the following discussions we have first of all to deal with the influence of the salts and metals on human metabolism. Though there has been no want of well deserving endeavours to explain this influence and though in recent times the most prominent physicians have devoted must time to investigations on mineral metabolism, we must admit, that these researches are only in their initial stages. We have further to admit, that we have scarcely reached such a stage, that we are able to profit from the physiological value of these processes, to say nothing of their importance in the pathologically altered metabolism.

As a basis for our knowledge of the value of the mineral salts in the nutrition of the organism L i e b i g's views have to be considered, who has already recognized in them the necessary agent for organic processes. The salts play still another part in the processes of the

animal body, as Beneke observed in the seventies, inasmuch as they furnish a certain amount of the materials for the building up and growth of the organism, which the latter retains. Liebig's ideas on the importance of the salts for the processes of nutrition appear in all later researches and have led to the conception of the so-called "nutritious" salts, the importance of which has been explained by Voit and his pupils. We cannot, of course, discuss here in historical sequence the proofs given by Forster, Bunge and others for the importance of the salts for the developing as well as for the developed organism. We can only mention here the results of their investigations, namely that only a small loss of salts causes a decline and eventually the death of the organism due to „salt hunger."

With regard to the intimate relations existing between the salts and the organic metabolism Voit's experiments on the influence of Na Cl upon the organic metabolism show that this salt — of all the body salts this passes most rapidly through the body — enters in great measure into chemical combination with the albumen of the blood, of the tissues, and of the humours. In this combination it forms a permanent constituent of the body and is consumed only in small degree, except in the case of a pathologically increased decomposition of the albumen, in which case it comes into circulation and is finally secreted.

We know further, that the absorption and assimilation processes can be effected only by means of the salts, since by the help of these the proteid is consumed. Köppe found, that assimilation of the proteid no longer exists after exhaustion of the salts in the organism.

Blood and salts are bound together in proportion, which varies within extremely small limits only, and the continuance of which is brought about with the utmost tenacity. We know, in what a wonderful way the permanent condition of the alkalies in the blood

and the humours is maintained by a certain self-regulation, as the neutralisation of the sulphuric and phosphoric acids which becomes free during the disintegration of albumen is provided for not by an abstraction of alkalies from the body, but by the alkalies conveyed to it in the food, especially by the ammonia formed by the disintegration of the albumen itself. The body has consequently a constant need of alkalies, since all acids produced in the body are combined with bases and thus secreted. Naturally the permanence of the fixed alkalies and thus the organism itself is endangered in all cases, in which an acid intoxication of the organism takes place, as is certainly the case in diabetes (diabetic acidosis), since the slightest changes in the alkalies contained in the blood as well as the humours are accompanied by most severe general disturbances.

The alkalies are, moreover, of importance as transmitter of the carbonic acid in the blood; they effect this transmission as bicarbonate or, as Siegfried showed, as carbamate of the aminoacids and of the higher products resulting from the splitting up of albumen.

Finally the alkalies serve as solvents for many albuminous substances in the humours, and according to recent investigations, they posses the extremely important function of forming globulins out of the albumin, which as the bearers of antitoxines are of special importance for the organism.

It may be mentioned, that the alkalies fulfill an important function in connection with intestinal digestion, since they render the pancreatic secretion active, and it is by their cooperation through the saponification of the fats, that the emulsifying action takes place, an action which is exercised by the secretions of the liver, pancreas, and intestine. We have thus demonstrated the necessity of the supply of alkalies for the organism.

Our knowledge of the metabolism of the salts, and in fact of the entire mineral metabolism, is extremely

limited notwithstanding the numerous investigations recently carried out. The fact, that our knowledge concerning the metabolism of the salts is so limited compared with that of the processes of the metabolism of the actual nutriments, seems less striking, if we consider, that in the era of the purely chemical conception of the processes of nutrition the interest of the physiologists was directed more to the study of the processes of decomposition taking place in albumen, fat, and carbohydrate than to that of the salts that pass through the body unchanged or nearly unchanged. Rubner was the first to put our knowledge of the processes of nutrition upon a new basis. By physical observations he was lead to compare the energy consumed by the human body with the decomposition of the nutritious substances, measuring the latter according to their calorific value. Since Rubner made these observations the role of the salts appears to us in quite a different light. Considered from this point of view the salts prove themselves to be not so much the useless admixtures to the organic nutrient materials but rather essential factors in the consumption of the nourishment as well as its assimilation, although not in the same sense as the organic nutrient materials themselves as the bearers of energy, which is transformed into motion. We obtain some idea as to the magnitude of this development of energy from the fact that the salt solutions — salts are found chiefly in solution in the body — by virtue of their mutual contact evoke the processes of diffusion and osmosis, which in turn induce an enormous number of currents and of counter-currents, whereas these currents and counter-currents, while tending to an unattainable balance, do not cease as long as there is life in the organism. Without going more deeply into the details of these physical and chemical processes we observe that the energy termed osmotic pressure — by means of which the exchange of the salts in solution takes place through the cell

membrane, thus letting the salt molecules and ions work — is set free for the organism and that its combustive value can be physically measured like that of the organic nutrients. Arrhenius has contributed much to the understanding of these processes by showing, that salts in aqueous solutions split up into ions, which are charged with positive or negative electricity. The appearance of electromotive forces in the organism depends upon this splitting up of the ions in aqueous solutions and upon the free passage of the freed ions through the membranes in the organism. Based upon these facts, which gave quite a new direction to modern investigations and rendered possible an easier understanding of the physiological action of the salts, a series of important experiments have proved, that the salts play an essential part in all the processes of the human body. We shall now briefly discuss that part in those cases, where the experiments have lead to clear results.

First of all H o f m e i s t e r 's investigations should be mentioned; to these investigations we are indebted for our knowledge of the intimate relations between the salts and the colloids (starch, mucus, and proteid substances), which enabled us to understand the role played by the salts in the precipitation of albumen. The relation between the reactions and effects of the salts and proteids was thus confirmed, whereas H a r d y was able to proove, that the mutual relationship between solution and precipitation of the colloids depends upon the atomicity and the intercourse of the free ions, and that every change in the distribution of the ions produces a change also in the constitution of the colloidal substances. Thus, the opinion prevaling at present regarding the salts is, that the effect of a salt corresponds to the resultant obtained from the effects of its ions, which upon the solution of several salts influence and act against each other mutually.

Of no less importance for our knowledge of the effects of the salts were the investigations carried out

in a series of experiments by Hamburger, Köppe, Hedin, Hardy, Overton, de Vries, and Limbeck, who determined the behaviour of salt solutions on isolated animal and vegetable cells. These investigations lead to important results with regard to the explanation of the physiological functions of the animal body, namely that in most animal species the cell and tissue liquids are subjected to a constant osmotic pressure, which they are constantly tending to maintain, and that every alteration in this peculiar osmotic pressure due to supply or loss of water leads to a shrinkage or swelling up of the cells, and thus to changes in their volume and shape. The salts of the blood and tissue liquids have the important function: to maintain a constant osmotic pressure, and thus to regulate the most important functions of life, which are dependent upon this constant osmotic pressure. If then, as we assume in accordance with modern views, all chemical reactions in the behaviour of salt solutions are to be referred to the action of the ions, we can also justly attribute to the action of the ions that phenomenon, which we call catalysis. Catalysis is for balneologists of such importance, that it cannot be overestimated.

According to Ostwald, we understand by catalysis the property of certain substances to retard or accelerate by their mere presence the speed of the reaction without the catalysors themselves being active at all or being consumed. The catalysors are supposed to change the concentration of the ions, which latter again are said to alter the speed of the reaction. In this connection the fact is of great importance, that two or more catalysors can produce a greater effect than that produced by their individual actions. On account of the extraordinary similarity of the action of catalysors to ferments and enzymes they are also termed inorganic ferments; to these are supposed to belong the

heavy metals and their oxides, and under certain conditions also their salts. Even in a dilution of 1 in 70 000 000 the metals possess the capacity of changing by catalysis the rapidity of the reaction. Of certain metals, such as iron, we know that they are oxygen carriers, and they have therefore been termed oxydases or oxydation ferments. Accurate experiments, among others those of our late collegian S p i t z e r, have shown that also metals and their salts possess the catalytic power of this oxygen transference, and that the metals represent the efficient agent of the oxydases of the blood. It is S c h a d e's merit to have pointed out, that the same effect is produced by metals i n t r o d u c e d into the organism, a fact, to which we owe our knowledge of the therapeutic effect of metals, the practical results of which were known long ago.

Due to the results of the above mentioned investigations a wide field has been opened up for physico-chemical research. The development of this comparatively young science will, it is hoped, soon place the therapy of mineral substances on a surer and undisputed basis. From this development the science of balneology too may hope to be especially advanced. For notwithstanding every acknowledgement of the endeavours that have been made to obtain scientific foundations for the experiences collected in this branch of science the fact cannot be disputed that, from want of a positive basis balneological therapy ran a risk of being undervalued and attacked or at least of being met with doubts. It may even be said that with regard to its real value balneology would certainly be in the position of a step-child of medicine, if not for the blind and unlimited faith of the invalids, which outlived the persistent doubts of science, a fact which is shown by the splendid development of most watering-places during the last two decades. No reproach should be made medical science for the raising of such doubts; they are an unavoidable result of the medical education of the younger generation

of physicians, which, based on the study of chemistry and physics, is only too readily inclined to deny everything that cannot stand the test of the seemingly exact methods. It must not be forgotten that, granted the precision of all the experimental methods, the processes and functions of life do not take place as those in a test-tube, quite apart from the fact that very frequently those theories are considered wrong to-day which were proved to be right yesterday. It is certainly evident from the countless contradictions of the new literature that even the most accurate and exact measurements and determinations, the most acknowledged methods of physics and chemistry become unreliable as soon as they are applied to the living organism. Notwithstanding this we are on the best way to solve the problems and clear up the doubts regarding the application of the mineral springs by the current theories of osmosis and electrolytic disassociation, though it would certainly be going too far, if we should attempt a classification of the mineral-waters from this point of view only, neglecting entirely the chemical analysis, which is considered the chief characteristic up to date. K ö p p e has grouped the mineral springs according to this principle, assuming as base the ratio of the non-splitting, i. e. the neutral, to the dissociated ions, which ratio is determined as a function of the freezing-point and the electrical conductivity. However, as A l b u and N e u b e r g have quite rightly remarked, we physicians do not yet understand how to read such a table, which may be the only right one from the purely scientific point of view. At present we have only to stick to the fact that the latest researches have supplied us with new ideas about the mode of action and application of mineral waters, though our knowledge may yet be a fragmental. However, the critical point has now been overcome and prescriptions have no longer a vague character, if we consider, that the mineral springs possess a certain amount of mineral matter, which even in the above mentioned ex-

tremely dilute solutions influence the termination of the reactions in consequence of their contents of free metallic ions, thus acting upon the retarded oxydation processes of the attacked organism. If we further consider, what a prominent share in the mode of action of the mineral springs is attributed to their contents of radio-active substances, and how their mode of action changes, according as they contain radium or its combinations, and if we realize, that perhaps other substances, which for the present are unknown, determine the mode of action of mineral springs, it will be clear, that we have to recognise in these powerful therapeutic agents, as has already been demonstrated by the experience of centuries.

At the conclusion of these discussions, for which the excellent work of Albu and Neuberg on the metabolism of minerals supplied valuable material, we summarise the effects of the minerals in the organism according to the above mentioned authorities:

1. They are cell and tissue builders. They take part to a different extent in the growth and in the formation of all tissues of the organism.
2. They bring about the osmotic tension in the cells and tissues, in the blood and humours, and are, therefore, indirectly transmitters of energy.
3. They regulate the reaction of the blood and of the humours as well as the action of many ferment processes, especially in the digestive canal.
4. They act as "Catalysors" for a great number of chemical processes in the organism. They act, for example, as oxygen-transmitters in connection with oxydation. They bring about the changes in the proteids in the cell protoplasm, which are inseparably connected with the functions of the latter.
5. They are the agents for the poison-producing and poison-removing processes, that are taking place

continually in the living protoplasm, maintaining a balance on account of their partial antagonism.

6. They probably act as agents for a great part of the so-called intermediary assimilation processes apparently more especially in the glandular organs. They augment and regulate everywhere the decomposition and assimilation of the organic substances.

CHAPTER IV

1. Chemical Composition of the Carlsbad Water.

Before discussing further the Carlsbad mineral water on its way through the human organism we give the results of the latest analyses made by Prof. E. Ludwig, Panzer, and von Zeynek, as shown in the following table. We call special attention to the striking fact of the practically complete agreement of these results with those of the analyses of earlier times, a fact, which shows us, that the hot-springs of Carlsbad are subject to no observable changes. The following table gives the average quantitative analyses of the Mühlbrunn per 10 000 parts:

Potassium oxyde	1,264
Sodium „	22,935
Lithium „	0,037
Calcium „	1,846
Magnesium „	0,779
Strontium „	0,002
Iron „	0,008
Aluminium „	0,003
Manganese dioxyde	0,001
Anhydrous sulphuric acid	14,122
Chlorine	6,140
Fluorine	0,023
Boric anhydride	0,021
Anhydrous phosphoric acid . . .	0,002
Silicic Anhydride	0,719
Carbonic Anhydride	22,006
Control sulphate estimated . . .	61,798
Control sulphate determined . .	61,852
Specific gravity	1,00527

Arranging the various constituents into groups of salts, we get the following values per 10 000 parts of water:

Potassium sulphate	2,337
Sodium „	23,171

Sodium chloride	10,132
„ fluoride	0,051
„ borate	0,030
„ bicarbonate	12,623(1)
Lithium bicarbonate	0,091(2)
Calcium phosphate	0,004
„ bicarbonate	3,293(3)
Strontium carbonate	0,003(4)
Magnesium „	1,628(5)
Manganese „	0,002(6)
Iron carbonate	0,012(7)
Aluminium oxyde	0,003
Silicic anhydride	0,719
CO_2 as bicarbonate	7,593
CO_2 uncombined	6,820
Sum total of the components	54,099

The composition of the water in equivalent percentage is according to C. v. Than as follows:

In 10 000 parts of water		Equivalent percentage	
K	1,0496	3,072	
Na	17,0260	84,638	
Li	0,0173	0,282	
Ca	1,3186	7,555	
Sr	0,0017	0,004	
Mg	0,4702	4,423	
Fe	0,0056	0,023	
Mn	0,0008	0,003	100 000
SO_4	16,9440	40,424	
Cl	6,1400	19,846	
Fl	0,0230	0,139	
B_4O_7	0,0234	0,034	
PO_4	0,0027	0,009	
CO_3H	21,0570	39,548	
	* *	*	
CO_2	6,820	17,761	
SiO_2	0,789	1,364	

(1) Corresponds to 20,001 Sodium carbonate.
(2) „ „ 0,167 Lithium bicarbonate.
(3) „ „ 5,335 Calcium carbonate.
(4) „ „ 0,004 Strontium bicarbonate.
(5) „ „ 2,825 Magnesium „
(6) „ „ 0,002 Manganese „
(7) „ „ 0,018 Iron bicarbonate.

2. Physico-Chemical Properties of the Carlsbad Water.

An exact physical examination of the Carlsbad hot-springs was carried out by v. Zeynek. Although we shall restrict ourselves only to the results of that examination, it is perhaps convenient for the understanding of the physico-chemical principles, which we shall often have to deal with, here as well as in the following chapters, to devote a few introductory notes to these physico-chemical principles. For this understanding the physico-chemical conception of the nature of a solution of a solid body in a solvent is of fundamental importance. As we know, those chemical reactions, which are of interest to us, take place in solutions only, while solid substances, which change their composition little or not at all. are not capable of causing reactions. The change, which a substance undergoes by its solution and which renders it capable of reaction, consists in its components being separated from one another; at the same time every component becomes electrically charged. This separation, as for instance that of Na Cl into sodium and chlorine-ions, is not in every case a complete one. It depends on various circumstances, above all upon the concentration of the dissolved substance. The greater the dilution the more complete is the separation, and the more concentrated the solution so many more undivided neutral molecules (for instance Na Cl molecules) will remain besides the ions. With regard to the origin of the electrical character of the ions found in solution we are aided by the assumption, that the force, which holds the substance together in the solid state, assumes in solution the form of an electrical charge of the ions and that the entire process is brought about by a specifical action — the dissociating power of the water. This decrease of coherence, during which chemical energy is transformed into electrical energy, is known

as electrolytic dissociation. We can confirm the presence of that electrical energy by bringing the poles of a source of electricity (galvanic cell) into contact with the solution. The poles absorb the condensed quantity of electricity from the ions, and an electrical current is thus generated. Such a solution, which conducts the electric current, is called conductive, and since it is only the free ions, which conduct the current, it is clear, that electrolytic dissociation and conductivity stand in a certain relation to each other. By measuring the electrical conductivity of a solution or, what is the same thing, by measuring the resistance, which such a solution offers to the passage of an electric current, this resistance can be determined to a great degree of accuracy by familiar physical methods, and we have a means for determining the degree of electrolytic dissociation of that solution. In this way v. Zeynek has tested the Carlsbad Sprudel as well as the Mühlbrunn and Franz Josef Springs, and has found the remarkable result, that the salts of these springs are dissociated on an average, up to 96,9 per cent, which is practically equivalent to a complete ionisation.

For the natural mineral springs the degree of dissociation of their salts has, as already mentioned above, gained such importance, because according to the present physico-chemical conception the physiological effect of their waters is to a large measure dependent upon their degree of dissociation. This doctrine supports balneotherapy inasmuch, as it advocates the use of the cure on the spot, being founded on the positive proof, that on the one hand the natural mineral waters in general are much more dissociated than the artificial ones, and that on the other hand the long storing of mineral waters in bottles gives rise to changes in the dissociation.

The determination of the freezing point forms an important sequel to the physical examination of the

electrical conductivity of salt solutions. While the latter indicates the number of free ions in a solution, as we have seen above, the former gives a measure for the molecular concentration, that is to say, it indicates the sum of the molecules and ions, which are contained in a certain volume of a solution. Molecular concentration has nothing in common with the general idea of concentration according to which, for instance, a solution of common salt containing 10 grammes of Na Cl in a litre would be regarded just as concentrated as a solution of sodium sulphate containing 10 grammes of $Na\,SO_4$ in a litre. For according to electrolytic analysis, equally concentrated solutions are those, which contain per unit of volume equal numbers of molecules, or, in other words, contain the dissolved substances, which for example may be again Na Cl and $Na\,SO_4$, in the ratio of their molecular weights in solution, i. e. in our case 58,5 gr. of Na Cl and 142 grammes of $Na\,SO_4$ per litre.

v. Zeynek found the following values for the lowering of the freezing-point (Δ) of the Karlsbad springs, which he examined:

Sprudel	$\Delta = -0{,}307$
Mühlbrunn	$\Delta = -0{,}293$
Franz Josef Spring . . .	$\Delta = -0{,}290$

Comparing these figures with the lowering of the freezing-point of the blood ($\Delta = -0{,}570$) we conclude that the molecular concentration of our water is decidedly below that of the blood.

By means of the determination of the lowering of the freezing point of a solvent as a consequence of the solution of a solid body, which is proportional to the concentration of the dissolved substance, we can, after having previously measured the electrical conductivity, find out in every case the number of undissociated or neutral molecules existing beside the free ions. The information obtained in this way about the molecular character of our water gives us at the same time also

some information about the sum of the various phenomena, which have a share in the generation of its osmotic pressure, whose magnitude is determined only by the number of molecules and ions, that is, by its molecular concentration. On the other hand the physical measurement of the osmotic pressure as well as that of the lowering of the freezing-point leads to a knowledge of the molecular concentration of a solution (osmotic analysis).

The close relation between osmotic pressure and the action of different mineral waters on the organism, more especially on the reabsorption and secretion in the stomach, make it a physiologically important factor in connection also with our water. The generally observed osmotic phenomenon, that two solutions separated by a semipermeable diaphragm remain in a state of balance, provided they are of equal molecular concentration or, what is the same, provided they are of the same osmotic pressure, has led to such solutions being termed isomostic or isotonic. If, on the other hand, the osmotic pressure on one side of the diaphragm is lower or higher than that on the other side, so that the conditions for an osmotic equalization are given, we call such solutions hypisotonic (hypotonic) or hyperisotonic (hypertonic) respectively.

In its relation to the blood we, therefore, call a solution isotonic, when it corresponds to the osmotic pressure of the blood. As such a solution we are acquainted with a physiological salt-solution, which contains 9 grammes of Na Cl per litre; from which it follows, that, as far as the osmotic relation of Carlsbad water to the blood is concerned, it must be hypotonic. This fact agrees with the determination of the osmotic pressure from the lowering of the freezing-point, which has been given by v. Zeynek as follows:

for the Sprudel	3,71	atmospheres
„ „ Mühlbrunn	3,55	„
„ „ Franz Joseph Spring .	3,51	„

while the osmotic pressure of the blood is generally given as about 7 atmospheres.

In 1905 the Carlsbad springs were carefully examined with reference to their radioactivity by Mache and Meyer, after Knett, Dorn, Hermann and Pesendorfer had already made qualitative experiments in that direction. With regard to details the reader is referred to the original works. It may only be mentioned here, that in Carlsbad the gases as well as the thermal water itself are characterized by a very high emanation, and that the cooler springs (Mühlbrunn, Schlossbrunn) are more favoured in this respect than the hot ones.

The disintegration velocity of the emanations of the springs is according to an exponential law, with constants, which in turn correspond well to the values obtained for radium emanation, so that we may conclude, that the nature of the emanation in the Carlsbad springs is identical to that of the radium emanation. As to the value of this emanation we cite from the tables of Mache and Meyer the following figures:

	Volts in 15 min.	Quantity in Q-litres
Müllbrunn	727	0,600
Schlossbrunn . . .	400	0,600
Felsenquelle	94,8	0,600
Marktbrunn	56,3	0,600
Franz Josef-Quelle .	40,4	0,600

The last "Sprudel" has an emanation value of the same order of magnitude as that of the Vienna conduit water.

The knowledge of the physiological importance of the radioactivity of mineral springs is still in its infancy. Of importance in this direction are the observations of Bergell and Bickel, according to which the retarding influence of the digestive process of the

Kochbrunnen of Wiesbaden, which contains common salt, is exercised only, when the water has lost radium emanation. An increase of radium emanation counteracts the retarding influence of the common salt springs and even reverses it. Upon the secretion itself radium emanation was without influence. In these investigations too the difference between the physiological action of a fresh mineral water from a spring containing emanations and that from one changed by export and storage is clearly shown.

CHAPTER V.

Mode of Action of the Carlsbad Water.

Since the Carlsbad mineral waters represent a solution of a mixture of salts, we must consider separately the single components of this solution, viz common salt, sodium sulphate, bicarbonate of soda and water. The reason for this procedure lies in the fact, that there have been but few experiments made with Carlsbad water alone, further that the physico-chemical explanation of the action of such complicated salt solutions is at present a matter of great difficulty, and finally that for the understanding of this action a knowledge of the single actions of the components themselves is necessary.

1. Re-absorption of the Salts in the Stomach.

Among the physiological actions of the Carlsbad water, which interest us here, the re-absorption both of the water and the salts will probably be easiest understood thanks to the investigations made by Strauss and Roth, Pfeiffer and others. Following the line of thought, as outlaid in the investigations carried out by Pfeiffer, we can easily understand those actions. If, for example, a salt solution introduced into the stomach or intestine has the same or a higher or lower molecular concentration than the blood-plasma (i. e. if it is iso-, hyper-, or hypotonic), then its total concentration adjusts itself to that of the blood, or at least shows a tendency to do so. With other words solutions, which are isotonic with the serum, do not change their total tension, hypertonic become diluted, and hypotonic solutions concentrated. On this point all observers agree with each other, while their views differ with regard to the question, as to how far physiological forces are active besides the physical ones.

The physical conception of these processes has been advanced by Höber, who was able to prove, that the rate of re-absorption of some salts as well as of sugar is proportional to their rate of diffusion, thus depending on the rate of dissociation of their molecules and on the velocity of their ions. Particularly hypotonic solutions, the behaviour of which interests us chiefly on account of the blood-hypotonic concentration of Carlsbad water, undergo in consequence of their stay in the stomach a greater lowering of the freezing-point, that is to say, their molecular concentration increases and that generally up to the nearly constant value of $\triangle = -0{,}45$. The lowering of the freezing-point of the blood-serum, as already mentioned, is $\triangle = -0{,}56$. The increase in the salt proportion, on the other hand, varies very greatly and is generally less apparent than the corresponding dilution of the hypertonic solutions. The change in concentration is also generally greater with solutions differing more from the serum, i. e. with dilute ones. Solutions of different salts of equal molecular contents undergo different changes in concentration in the same individual, just as equal concentrations of the same salts may undergo different changes in different individuals. Isotonic solutions change their concentration very little or not at all, they remain isotonic. At any rate with all these actions on animal membranes their quality plays an important part, and similarly our knowledge about the absorptive capacity of the stomach and intestine compels us to assume important differences in the permeability of these membranes for water and salt molecules. In this respect the proof given by v. Mering and Moritz, that water is not absorbed in the stomach, but can be secreted by it, is of importance. Concerning the absorption of salts Cohnheim has asserted, that the intact intestinal wall permits only the passage of Na Cl into the blood, but not vice-versa, while according to Strauss and Roth as

well as according to Pfeiffer a diffusion of chlorine molecules is possible into the interior of the stomach as well.

The re-absorption of sulphate of soda, to which, Pfeiffer restricted his investigations, increases with increasing concentration; at the same time common salt molecules replace the molecules of sulphate of soda in the stomach, and in such a manner, that with isotonic solutions of sulphate of soda as well as with weak hypotonic solutions (1,9%) just as many salt molecules pass into the stomach as pass out of it. In decidedly hypotonic solutions of sulphate of soda more molecules of common salt pass through the stomach wall, than sulphate of soda molecules pass out of it; and finally more sulphate of soda molecules pass out of hypertonic solutions, than common salt molecules enter the stomach. Experiments with solutions of common salt do not therefore afford a clear insight into the processes of absorption in the stomach, since the determination of the chlorine contents of the stomach gives no information as to how much chlorine has left the stomach and how much has entered it.

The re-absorption of the above mentioned hypertonic solutions can, therefore, easily be considered from the physical point of view. On the one hand a movement of the salt molecules takes place, and on the other hand one of water; and, as we have seen, more molecules actually pass from the more highly concentrated solution than pass into it from the blood serum. Thus the osmotic pressure falls, and the water flowing into the stomach acts in the same manner.

Isotonic solutions can be absorbed by diffusion. If at the same time there are on both sides of the separating membrane two solutions of different salts, as is the case in the passage of sodium sulphate into the blood, then, since the partial pressure on the opposite side for each of these salts is zero, they will pass the membrane in opposite directions, until there is no longer

any fall of concentration for them. In the case of a constant total concentration serum salts will, theoretically, enter the stomach until their molecular concentration equals that of the serum. On the other hand, since the sulphate of soda molecules entering the blood are constantly being carried away, so that the partial pressure always remains zero, all such molecules introduced can disappear again from the stomach or intestine.

The increase in the concentration of hypotonic solutions of sulphate of soda in the stomach is also easily explained: a flow of water to the blood, i. e. a re-absorption, does not exist. Thus a movement of the salts only can exist and it actually happens, that the membrane separates two solutions, of which the one with the less diffusible composition, that is, the blood solution, possesses a higher molecular concentration than the more easily diffused sodium sulphate. Under these conditions more of the more slowly diffusing molecules can penetrate the wall in unit of time than of the more rapidly diffusing ones, that is to say, more molecules travel in that direction, in which the movement should really take place more slowly.

If a sodium chloride solution of smaller osmotic pressure than that corresponding to the serum and especially than the sodium chloride partial pressure of the blood serum were brought into the stomach, it would on account of the difference of the permeability of the wall behave, as if it was composed of two salts of different nature and different diffusibility. The results of these observations are upset owing to the obviously individually different influence of the stomach humours, the secretion of which influences the increase in the concentration of the hypotonic solutions in an undeterminable manner.

2. Absorption of Carlsbad Water in the Stomach.

In the case where the hypotonic Carlsbad water is brought into the stomach, it is evident from the above, that there is a possibility of a complete absorption of the sodium sulphate in the stomach, since its partial pressure in the blood is zero, and that such an absorption actually takes place according to the condition of the absorptive capacity of the gastric mucous membrane and the motoric function of the stomach. The same does not apply to the chloride of sodium, whose partial pressure in the Carlsbad water is considerably below that of the blod (0,1 per cent against 0,55 per cent), so that the compensation of the hypotonicity of the water is effected by the chloride of sodium of the blood, the more so as the exchange for the sodium sulphate passing over into the blood, as above explained, takes place at the expense of the chloride of sodium in the blood. With regard to the sodium bicarbonate, which belongs to the difficultly diffusible salts, an equilibrium is possible on account of the approximately equal partial pressures in blood and water. Thus, in normal cases an isotonic or weakly hypotonic water free from sodium sulphate or containing but little of it reaches the intestine after having been for a shorter or longer period in the stomach. Here isotonicity takes place in all cases, and thus prepares the way for a complete absorption of the water as well as of the salt. The changes, which our mineral water can undergo in the stomach, are of course not essential for its passage into the intestinal canal. The circumstance, that it is the hypotonic character of the water itself, that favours a quick passage from the stomach, makes it probable, that the water leaves the stomach partly unchanged. Aside from individual circumstances the amount of water drunk plays an important part in this connection, as it can, without doubt, considerably modify the behaviour and the actions in the stomach and intestine.

3. Influence of the Specific Secretion of the Stomach.

Regarding the actions on the stomach, particularly the influence of the specific secretion of the salts contained in our water and of the water itself, much space has been devoted to that subject in the above discussion on the actions of the salts. In the results of the numerous researches engaged with the problem in question we recognize here above all the variety of the methods of those researches. Since the different salts were examined sometimes in the solid state, sometimes in solution and in various degrees of concentration, since further in some cases they were examined in the form of natural mineral water, it cannot be expected otherwise but that not only the different salts but also one and the same salt show greatly differing results. With this variable behaviour does also agree the simple physiological consideration, that one and the same stimulant can produce, according to its intensity and duration at one time an exciting, and at another time a paralyzing effect. Thus the recent classification of salts into secretion-preventing and secretion-promoting ones appears rather doubtful. This has lead in practice to an unjustified overestimation and underestimation respectively of the value of the various curative springs and has particularly given the common salt springs a kind of monopoly as secretion-promoting waters, which they do not possess by any means. The assumption of a specific acid-forming property of common salt is certainly strongly supported by K o e p p e's most convincing statements, that the formation of H Cl takes place in the interior of the stomach and that its source is to be found in the chlorine ions of the dissociated sodium chloride of the stomach contents on the one hand and in the hydrogen ions on the other. The latter are supposed to enter the stomach from the blood to replace the sodium ions, which have passed out of the stomach, and to form hydrochloric acid

with the chlorine ions. Many reliable observations have shown, that sodium chloride in the concentration of most sodium chloride springs doubtlessly favours the formation of hydrochloric acid. This action has been confirmed for the natural common salt springs of Wiesbaden and above all of Kissingen by the researches of Meinel, Bickel and Dapper; the last mentioned especially has found a normal acid value to take the place of a decided subacidity. In proper appreciation of the principally important distinction between the direct influence, as observed in single experiments with such salt solutions, and the total effect, as the result of experiments continued over a long period, Dapper has observed after Rackoczy-cures a decrease in an initially increased hydrochloric acid secretion, results similar to those previously found by Jaworski as typical to the Carlsbad cure, a matter, to which we shall refer later on. The investigations of Rzentowsky, however, show that the acid-producing action of sodium chloride is itself limited. He found, that with only weak hypertonic solutions there was never an increased secretion of HCl, but simply a dilution of the gastric juice; and he also found, that weak hypotonic solutions remain a shorter time in the stomach than hypertonic ones, a behaviour, with which the observations of Pfeiffer on sodium sulphate solutions also agree. It seems, that the secretion-disturbing solution takes place less easily and rapidly with sodium chloride, this distinctly physiological salt, than it does with $NaHCO_3$ and Na_2SO_4. The reason for this is probably to be found in the fact, that on the one hand $NaHCO_3$, especially in hot solutions, acts like a mild lixinium on the cement substance of the epithelium, dissolving it, whereas on the other hand the sodium sulphate, on account of its greater affinity to water, hurts the gastric mucous membrane more than common salt does, of which proportionally higher concentrations can be withstood. It is a pity, that no satisfactory experiments have been made on

the behaviour of sodium sulphate in concentrations, as they are met with in our water; the experiments of Heinsheimer, who found with a 3 per cent solution of this salt a retarding effect on the formation of HCl, are of no value for our purpose. At least we may confront these experiments with those of Gintl made at Riegel's clinic, who found, that a 1 per cent solution of sodium sulphate had no perceptible influence at all on the acid secretion of the stomach.

While the influence of sodium sulphate requires still further clearing up, the investigations available on sodium bicarbonate speak undoubtedly for at least a partial dependence of the secretory influences of the salts on their concentration. In this connection mention should be made of the investigations of French physicians, among whom Linossier and Lemoine have found, that weak (0,5 g), medium (1,0 g) and strong (5 g) doses of sodium bicarbonate, taken an hour before meals, increase in a varying measure the secretion of HCl both with regard to the duration and intensity of its action. For the above reasons and from his own experience Mathieu also recommends in cases of hypopepsy with atonic condition of the muscles bicarbonate of soda before meals, since then the mucous is dissolved, the HCl is increased, and especially warm solutions promote the action of the motoric function of the stomach. Du Mesnil arrived at a similar conclusion from his experiments in Leube's clinic, proving that small doses of sodium bicarbonate as well as the Mühlbrunn of Carlsbad increase the secretion, while larger doses reduce it. Compared with these experiments on the human body, the influence of $NaHCO_3$ upon dogs is only of secondary importance. Such experiments have been made by Pawlow and recently by Heinsheimer. The latter observed a slight diminution of secretion and acidity after administering a one per cent solution of bicarbonate of soda and a very marked and longer lasting reduction of secretion and

acidity after five per cent solutions. The experiments on dogs made by Gilbert confirm the observations made with sodium bicarbonate in the human organism. He also observed an alkalinisation of the stomach of short duration, as the result of weak solutions of this salt, which however was followed by a marked increase in the secretion. If, from what has been said above, it should seem very improbable, that the total effect of the salts of our water principally is a depressing or stimulating one, the observations of Jaworski afford direct proofs, that it is impossible to speak of a uniform action of the Carlsbad water, and that, apart from the above mentioned individual behaviour of the stomach towards salt solutions, external circumstances, such as temperature, quantity, mode of drinking and, as it seems, above all duration of the cure, apparently influence their effect. Jaworski, for instance, produced by giving 250 g of Mühlbrunn an excitation of the gastric mucous membrane for the secretion of acid in a most marked manner, at all events greater excitation than could have been produced by means of ice-water. Larger doses of Carlsbad water (500 to 750 g) remained longer in the stomach than small ones, and retarded the rapid disappearance of the salt as well as that of the acid contents of the stomach, which we noticed with smaller doses. It is of interest to observe, that Jaworski had confirmed the rapid disappearance of the sulphate from the stomach, although not all the conclusions drawn from the results of his experiments could be maintained to-day. Of special interest for the understanding of the effect of our cure is the fact stated by Jaworski, that after prolonged use of the Carlsbad water not only the acidity of the gastric humours becomes greatly reduced, but also the digestive power becomes weaker, and especially in cases, where the function of the stomach was normal or where hyperacidity existed. On the other hand Jaworski observed after long continued use of smaller

quantities of the water an increase of acid secretion especially in cases, where it was more or less wanting originally.

The difference already mentioned between the immediate action of our waters and the total effect of a cure continued for many weeks is also confirmed by the large number of observations of other investigators. We mention here the investigations of Spitzer, Ewald, and Sandberg, which, though not entirely, yet to a great extent, have confirmed the results of Jaworski, viz: raising of the HCl value and of the pepsine secretion as well as improvement in the emptying of the stomach as the immediate result of the Carlsbad water. Bickel, however, found no material change in the function of the stomach after the use of Carlsbad water. As far as the total effect of the water is concerned, Ewald, Reichmann, and also Spitzer found fluctuations in the acid formation, and in single cases also an increase in the acid value to normal, but they failed to detect any great decrease below the normal so detrimental to the stomach's function as was observed by Jaworski. The recent investigations of Fischmann in v. Noorden's clinical hospital bring an exact confirmation of the conclusions allowable up to date, for which we do not claim a law, but only a rule, probably with many exceptions. Fischmann was able to prove an increase in the hydrochloric acid secretion as the result of the direct action of the Carlsbad Mühlbrunn, whereas the total after-effect of the cure manifested itself in a decided diminution of the surplus acidity. Finally v. Noorden himself confirmed this by a few observations apparently planned on a larger scale. These observations show, that the total effect of about four weeks' use of the Carlsbad water in cases of hyperacidity in connection with atony or gastric ulcer manifests itself in the form of a diminution of the hydrochloric acid secretion up to 50 per cent, a result, which could not nearly be obtained from a similar cure with Neuenahr and Vichy water.

We can thus look with satisfaction upon the results of these latest investigations and be grateful, that the "gaps" in our balneological knowledge mentioned by v. Noorden are about to be filled by him.

4. Influence on the Intestine.

The behaviour of salt solution in the intestine is less accessible to investigation, and therefore also less clear. Of the transformation of hypo- and hypertonic solutions — according to Otto considerable quantities of the latter reach the intestine — into isotonic solutions mention has already been made; and for this was claimed a movement of the salt molecules from the intestine in the direction of the blood, as well as a passage of water into the hypertonic solutions, and finally an energetic absorption of water from the hypotonic solutions. There is no general limit to the amount of absorption of the introduced salts. It may be a complete absorption, as can be deduced from examination of the motions, and would be such, if not for the peristaltic action especially characteristic of sodium chloride and sodium sulphate, which brings about a partial evacuation of the bowels, before the final absorption has taken place. The influence of our own and other mineral waters on peristalsis, and especially the circumstance, that by the same means diarrhoea as well as constipation, quite opposite disorders, can be treated, meet with doubts not only among the laity, but also in professional circles. The explanation of the aperient effect of hypertonic solutions of bitter water and the customary doses of Carlsbad salt is of course very simple. These leave the stomach highly concentrated, produce a rich flow of water into the intestine and bring about as a result of more or less pronounced stimulation of the peristalsis mostly thin evacuations. This effect, however, does not always take place; it is often lacking, and at times even the opposite happens. Upon consideration of our above explanations this is easily under-

stood. It needs only be assumed, that such solutions become diluted in the stomach into isotonic ones as a result of their longer stay there, that they also lose a greater part of their salts, and that in this way, so far as the intestine is concerned, the cause for a stronger separation of water is eliminated. If this be accompanied by a rapid absorption of the salts in the intestine, the peristaltic stimulation can thus be reduced so much, that it no longer suffices for the counteracting of the intestinal sluggishness. We have further to consider, that for the provision for an abundant secretion of water in the stomach and upper part of the intestine as well as for the water retention, which the blood requires for the absorbed salts, sometimes even an increased absorption of water from the lower part of the digestive tract is required. This would naturally cause an increase of constipation. Perhaps the apparent paradox can be cleared up in this way, that sometimes, when large doses of such solutions fail to produce the required effect, small doses are effective, since the latter are able to excite peristalsis without interfering too much with the water balance of the digestive organs. The aperient action of hypotonic salt solutions of the Carlsbad springs can be understood from a similar point of view to that for the hypertonic solutions. Instead of withdrawing water from the stomach and intestine, as the hypertonic solutions do, they actually supply them with water, whereas on the other hand they deprive them temporarily of some common salt. On account of their small sulphate of soda contents, however, they lack that powerful peristaltic stimulation which the hypertonic salt solutions actually produce. From what has been said, it is clear, that hypotonic waters guarantee just as little or even less an aperient action, and that under certain conditions they even cause constipation. This is generally the case, if the water remains longer in the stomach, and sufficient time is allowed for a complete absorption

of the sulphate of soda; a nearly ideal solution of common salt and sodium bicarbonate can then reach the intestine, which so far as peristalsis is concerned is indifferent, and only affects absorption. The rapid entrance of sodium sulphate into the blood and at the same time its increased attraction for water may be considered here in the sense of a drying up of the lower portions of the intestine. In practice we know well, how to avoid all these eventualities as far as they are undesirable by modifying the method of drinking the waters accordingly. Where an aperient effect is required of our waters, larger doses of water of a lower temperature are prescribed, since this remains, as a rule or a shorter period only in the stomach. The hot Carlsbad springs taken in small doses have proved to be a superior remedy in various cases of diarrhoea, because they make it possible for the intestinal mucous membrane to be washed by a perfectly unirritating, so to speak, physiological salt solution free from soda sulphate, and at the same time produce physical and physiological effects, which do not at all stimulate the secretion increased already in such cases, but on the contrary induce alone a movement of water and salt from the intestine to the blood, thus supporting our efforts of cure. Exceptions to this, in which the thermal stimulation of high temperatures cause more rapid peristalsis than those of low temperatures, do not disprove the rule. This effect can be rendered more complete by a neutralisation of the fermenting acids probably present in the intestine, as well as by a corresponding dosage of water, an active evacuation thus being maintained, which assists greatly in the removal of the stuffs liable to fermentation. For, as has been proved, the formerly assumed decomposition-preventing and disinfecting influence of the neutral salts in intestinal digestion depends less on their direct antibacterial action than on the fact, that as aperients they prevent these processes.

The delay of the decomposition processes in the intestine, which can be explained by the above mentioned phenomena and for which the determination of the amount of ethyl-sulphuric acids in the urine is a certain, though not an objectionless measure, has been verified by Fischmann's experiments, where under the influence of Carlsbad Mühlbrunn a considerable decrease of the mentioned acids, more especially if these were increased considerably previously, has been confirmed.

Finally mention may be made of the widely spread idea, that intestinal digestion is necessarily rendered more difficult by the influence of the mineral water cure. Strange ideas prevail as to what can and what cannot be digested by the stomach and intestine when subjected to such cures, especially those of Carlsbad. It is not long since that fat and especially butter were believed to be indigestible and even dangerous if combined with our water. All these fears and exaggerations were dispelled by the convincing and exact experiments on digestion, which were made with most of the mineral waters, especially those of Carlsbad. We are indebted to Ludwig and F. Kraus for the proof of the important empirical fact, that the use of the Carlsbad water is in no way detrimental to digestion, whether that of food or fat. The considerations, which the diet of our patients demands, are in general in Carlsbad none other than those required by the recognised principles of dietetics. They depend on the individual requirements of the patient. Nevertheless the use of the water itself imposes certain restrictions, and it would be a grave error to recklessly disregard them in consideration of the results of the experiments on digestion above mentioned. The fact that the mucous membrane of the digestive organs, and especially of the stomach, becomes specially sensitive to hard, raw and stimulating food upon the use of the hot springs (over 50° C.), requires under all cir-

cumstances very careful consideration as to the mode of administration and preparation of the food, in order to avoid grave disorders in some cases.

5. The Behaviour of the Absorbed Salts and their Influence on the Organs and on Metabolism.

The disappearance of the salts from the intestine raises the question as to whether there is an increase of salts in the blood arising therefrom. In spite of the many investigations made for the purpose of verifying an increase of salts in the blood the results of which are frequently contradictory, the hopes of being able to establish such a result by means of a determination of the osmotic pressure and of the lowering of the freezing point have not yet been fulfilled. The fact, that simultaneously with the salts water is also absorbed from all salt solutions, obviously renders osmotic analysis less suitable for the purposes mentioned above. Moreover, the proof of a retention of alkaline salts, owing to an accumulation of which in the blood a volumetric measurable change in the reaction of the blood might be expected, has so far given only a partial explanation of this question. Among other investigations those of F r e u d b e r g offer information on this point. He was able to confirm by v o n J a c k s c h's method after the administration of 5 to 15 grammes of $NaHCO_3$ an increase in the alkalinity of the blood of about one fourteenth in three cases; in two cases no change whatever could be detected, though the urine became strongly alkaline in all cases. The alkalinity is as little altered by 4 to 8 grammes of medical hydrochloric acid as by alkali itself; on the other hand lactic acid, which oxidises in the blood, reduced the alkalinity of the latter by $1/5^{th}$ to $1/4^{th}$. The acidity of the urine was found to be always higher after HCl, and lower after lactic acid. At all events these observations demonstrate, how narrow the limits

are, within which the salt contents of the blood vary and how energetically the above mentioned automatic regulation works for the constant maintenance of this state and of the reaction of the blood. Still the fact must not be overlooked that all these valuable results have been obtained with healthy persons and can thus be applied only to such; this does not, however, exclude the possiblility, that the blood may not in cases of sickness readily make use of any surplus, superfluous in times of good health.

In spite of the unsuccessful investigations as to what becomes of the absorbed salts in the blood we must assume a temporary stay in the blood of those salts introduced in excess of the necessary amount, at least for a period lasting from the re-absorption up to the secretion by the kidneys. Although this period may in general be a very short one, it can be extended at will by a corresponding distribution of the supply and an extension of the period of supply; it is thus evident that such momentary actions can finally combine to a considerable total effect.

On the above assumption is based the long-established and universally adopted application of alkalies in cases of uric acid diathesis, gout and diabetes, and there is no want of positive proofs that in these cases the balance between acid and alkali can, under certain conditions, be greatly disturbed, so that the alkalies actually serve their purpose. Though the increased formation of acid in the organism cannot under these conditions be confirmed by an examination of the blood, yet the urine shows hereby usually a relatively too great amount of acid. With regard to the uric acid diathesis and gout this follows from the investigations of Ritter, who found that the sediment formation of amorphous and crystalline uric acid, which is wrongly regarded as being pathognomonic for such conditions, is only the consequence either of an excess of acids in the urine, or of a deficiency of dibasic

phosphates. As the values of these acids often become so large that they cannot be made up for by the total phosphoric acid that is simultaneously present, even on the assumption that the latter exists as acid phosphate, this acid residue must in the meantime be referred to unknown acids. This question also has recently been settled by N e u b a u e r, who by the absolutely reliable method for the determination of hydrogen ions was able to disperse all doubts as to the correctness of the above results. The conclusion drawn by R i t t e r thus becomes a certainty viz, that in the uric acid diathesis and gout we have to fight not so much against the imaginary presence of free uric acid, as assumed by P f e i f f e r, as against an excess of an unknown acid.

The antiquated conception, according to which uric acid diathesis and gout were regarded as due to the same metabolic disturbances, was at least consistent in that it demanded a similar treatment of these two diseases. Accordingly the alkaline method of treating gout, which had been in vogue so long a time, is now so well founded empirically that the differentiation of both conditions, which is carried out in the theory at least, will hardly bring about any change in this direction. For, if it is correct that in gout a retention of uric acid in the blood corresponds to the more or less constant decrease of the amount of this acid in the urine, the alkalinising and at the same time rinsing action of our water would fully enter upon its claims; and moreover the direct influence through the blood would not appear so hopeless as F r e u d b e r g thought to have the right to conclude from his experiments. For, as under the influence of the lactic acid in these experiments the alkalinity of the blood was diminished by 1/4 to 1/5 th, every increased formation of organic acids in the blood must finally get a temporary or permanent hold of a corresponding amount of alkali or at least put it out of action, for the effect of the H Cl

supply upon the alkali of the blood cannot well be imagined otherwise. The reduction of alkalinity considered from a purely chemical point of view means, however, for the acid sodium urate in the blood nothing but an improvement of its solubility. As is well known acid sodium urate is nearly insoluble in the blood as well as in corresponding salt solutions. Its solubility increases with its decreasing salt- or alkali-contents respectively and is greatest in pure water. It is disengaged from all its solutions by easily soluble salts, such as common salt and sodium carbonate, with which Ritter associates the frequent appearance of gouty paroxysms during the Carlsbad cure, a phenomenon which Haig also recognises as a direct momentary effect of many mineral water cures. On consideration of these conditions of solubility the introduction as well as the increased formation of acids must render the blood on account of its decreased alkaline contents more susceptible for the reception of the urate of soda. This object is thus attained by the modern method of treatment of gout with large doses of H Cl, and the question might well be discussed as to whether such a method of treatment might not be worthy of recommendation in consideration of the real value of the solution of uratic deposits. We observe here that in the first place the supposition which has led to this acid treatment, and according to which gout is associated with achlorydria or hypochlorydria of the gastric humours, is based on false principles. The contrary is true, as the author was able to confirm in numerous cases during and after acute attacks of gout, since in all these cases higher H Cl values of the gastric humours were found. Even if this were not the case, the question arises as to what should be regarded here as the healing process: the absorption of urates, which are rendered harmless in the deposits, or their separation from the blood even at the risk of an attack of gout. The answer is rendered easy, when we realize that in the one case

the blood is freed of uric acid, while in the other case the uric acid remains in the blood, so that both the blood vessels and the organs themselves become exposed to its irritating effects.

The acid binding and washing effect of the alkalis is most clearly and certainly proved in the acidosis, which so frequently occurs in the course of diabetes. As has been shown by Weintraud, Meyer and Magnus Levy, the removal of acetone is increased by bicarbonate of soda, that is, acetone is not only present as such, but it is also transformed into acetic and oxybutyric acids, passing through the kidneys in combination with alkali. The final effect of the introduction of soda during the usual course of diabetic acidosis is here a considerable increase in the less completely oxidized acids and acids products made urinous by the soda. We shall return to this subject on the discussion of the influence of alkalis on oxydation processes in general.

Another property of alkalis in connection with the blood, which we have to consider here, is their influence upon the permeability of the red blood corpuscles. This consists according to Hamburger in the fact, that these corpuscles are protected by alkalis from the decolourising action of bile and bile acid salts. Buchner also points out, that alkalis are effective not only in insuring a definite degree of concentration to the plasma (thus being of osmotic importance), but also in possessing a specific importance for the life of the red blood cells. This fact deserves our special attention, since, as Buchner observes, the role of our waters in cases of jaundice is not restricted alone to their influence on the causes of disease, but at the same time also the retardation of the dreaded blood dissolution comes within their sphere of action.

The consequences of icterus form less than its causes one of the most important cases for the application of our salts and waters. How-

ever well established with regard to practical experience the mode of action of our waters is, in fact, as well established as any internal medicinal mode of treatment, the explanation of their mode of action still offers great difficulties. This mode of action is quite easily understood in cases of catarrh of the stomach and duodenum. The water comes into direct contact with the diseased parts and exercises its influence in the manner discused above. On the other hand such an explanation would not be sufficient in cases of cholangitis and cholecystitis; here we must have recourse to an action of the salts resulting from those absorbed from the blood which, due to an increased secretion, be of mucus or of bile, causes a diminution in the swelling of the mucous membrane as well as a dilution and washing away of inflammatory material. The accessibility of the mucous membrane of the bileducts for internal remedies has often been questioned, but certainly not with justice. It certainly cannot be proved by experiment. Why should these mucous membranes, on which we depend so much in diseases of other mucous membranes, be excluded from being influenced by salts? Do we not assume for instance in the case of the effect of Ems water upon the bronchial mucous membrane an action through the blood, and does any one doubt such an action? The fact, moreover, that Carlsbad water renders great services in the promotion of a frequently very abundant expectoration and secretion from the nasal and pharyngeal mucous membrane has long ago been acknowledged not only by medical observers but also by the laity, although these are chiefly secondary effects, which take place during the use of cures taken for other purposes. The hypothesis of an analogous effect also on the bileducts is thus founded on an absolutely plausible doctrine, according to which it is most probable, that especially in the intestine not only we have to reckon with a contact effect of our water, but that there, too, a part

of the effect is produced by the absorbed salts. This last mentioned effect is due to an increased secretion of the mucous membrane, irrespective of whether salts are secreted on its surface or not. Above all we must not forget in connection with the specific secretions of the stomach and intestine, when subjected to the influences of the salts, the importance of the mucous secretion itself, upon which the salts seem to act most effectually. The observations of Kaufmann supply interesting material on this subject. He is inclined to attribute the favourable effect of lavage of the stomach with silver nitrate in hyperchloridria chiefly to an extraordinary favourable effect on the production of mucus.

In contrast to the discussed effect on the mucous membrane, which is difficult to confirm experimentally, a large number of experiments on animals in addition to less trustworthy observations on the human organism has been devoted to the cholagogue action of our waters. Of these experiments only those of Lewascheff and Glass will be referred to here, as their results present the opposing views on this question. In his first series of investigations Lewascheff confirmed after administering four grammes of sodium bicarbonate without water a significant increase in the bile secretion besides an initially increased and afterwards decreased consistence of the bile. When dissolved in 300 grammes of water, the action of sodium bicarbonate was still more effective, and the bile became much thinner. Sodium sulphate up to four grammes produced an increase in the secretion similar to that obtained with sodium bicarbonate. The mineral waters of Vichy and Carlsbad were much more effective than the ordinary salt solutions, and the effect lasted for several hours. In a second series of experiments the same scientist observed under the influence of the Carlsbad Sprudel a tendency towards an increase of the secretion, while the density of the bile at first increased

and afterwards decreased. With weak solutions of $NaHCO_3$ he found a relatively greater effect than with strong ones. A 1,5 per cent solution acted like a 0,5 per cent one, but the latter acted longer than the former. Similarly 0,5 per cent solutions of sodium sulphate were found to act longer and more powerfully than 1,5 per cent ones. Glass, on the other hand, draws the conclusion from his experiments, that alkalis per os do not reach the bile, that the alkalinity of the bile is not increased, and that finally salts of sodium (Na_2CO_3, Na_2So_4, NaCl) have no cholagogue effect. Those acquainted with the difficulties encountered in such experiments as well as those involved in a correct interpretation of their results will scarcely be surprised at the different conclusions drawn; in the meantime it is, therefore, better to form no decided view on this subject, but to wait for further experimental progress in this direction.

The observations of Frey show with what caution the results of such investigations should be judged and how much one should be on his guard against generalizing the results of the so called acute experiments. Frey found, that salicylic acid, chloral hydrate and colchicin increased the bile secretion upon prolonged use only. These remedies act, according to Frey, probably at first, due to changes in the circulation of the blood, as cholagogues, since every change in circulation produces first only an increase in the bile without bile acids. The increased circulation, however, raises in time also the specific activity of the liver. Can we not, under such circumstances expect similar results with the salts? For the liver is, as it were the first halting-place, which the salts after absorption reach on their passage through the portal vein, in order to produce there a brisker osmosis and thus a more active circulation of the organ with regard to secreting and regenerative effect. Only in this way and on considering the circulation in the abdominal organs, which regulates intestinal secretion, can we form a conception of the healing processes, which we generally

attain with our cures in cases of active and passive hyperaemia of the liver in the initial stages. We should, thus, not underestimate the value of such cures even in cases, in which the conditions have already led to irreparable tissue changes and thus have become the cause of icterus. In spite of the negative results obtained from experiments on animals we cannot renounce all these conclusions, especially as far as the secretion of the liver under the influence of salts is concerned, until the proofs offered are entirely freed of all misleading errors and ambiguities. This standpoint is justified not only by the above mentioned theoretical considerations but also by the valuable observation made by B a i n in the case of a man with permanent biliary fistula besides complete occlusion of the choledochus. In the case of this man B a i n was able to prove, that Carlsbad water is a cholagogue, which increases not only the amount of the bile secretion, but also the dried residue. From this observation of Bain it also follows, that the effect depends on the salt contained in the water, for the water alone was without effect upon the bile secretion as V o i t already showed a long time ago. Moreover, the manifold clinical experience justifies us i n a d h e r i n g t o t h e c h o l a g o g u e a c t i o n o f o u r s p r i n g s, and above all we count upon it in the t r e a t m e n t o f c a l c u l i o f t h e b i l i a r y p a s s a g e s, though we are certainly not going so far as to maintain, that the internal treatment of gallstone therapeutics is successful or not according to the cholagogue effect of the remedy. Instead of the earlier conception, according to which the aim of treatment was the expulsion of the gallstones, and the mechanical means for attaining this end an as abundant flow of bile as possible, it is generally believed to-day, that the only attainable and desirable aim of internal treatment lies in the restoration and maintainance of the latency of evidently existing gallstones. The fact, that cholelithiasis does not as a rule manifest itself as a

disease, but that in the great majority of cases it acts in concealment making the sufferer only temporarily really ill and fortunately only seldom earnestly endangering his life, directs the attention of the physician to the causes of the interruption of that latent condition and their removal rather than to the removal of the gallstones themselves. We have already learned to recognise the inflammatory states of the bile-ducts as the most important causes of this kind and, expect in just such cases, as we have indicated above, valuable aid from the cholagogue action of our waters. As, however, such inflammatory conditions of the gall-bladder and bile-ducts are by no means always, in fact probably only in the minority of cases, primary ones, i. e. the result of the irritation of calculi and infections of the intestine, and as they are just as frequently propagated from the stomach and intestine into the bile-ducts, our treatment becomes in these cases a treatment of the digestive organs. Most intimately connected with the latter anatomically and physiologically the gallbladder takes part in all, especially in their motoric disturbances, so that there is hardly an anomaly of these organs, which does not affect the gallbladder. Experience teaches that this is generally the case, if this organ itself has become a locus minoris resistentiae in consequence of the presence of calculi. The same conception of the problems of the internal treatment of cholelitiasis and especially of the alkaling saline waters is also defended by N a u n y n, who lays great weight on preventing catarrh of the bile-ducts and on avoiding all forms of congestion, as well as favourably influencing the activity of the stomach and intestine, since according to his opinion in opposition to ours we are able to act upon the mucous membrane itself little or not at all. According to N a u n y n our waters thus stimulate peristalsis and regulate the blood circulation in the abdominal organs. The same view is held by K e h r. His uppermost principle for the internal

treatment is the restoration of rest in the biliary system, and for this purpose he prescribes the Carlsbad hot springs. That the hot springs actually serve this purpose, has been fully confirmed by the author in the course of his long experience at Carlsbad which is based on the observations of over 4000 cases of gallstones. According to the author, "Severe colic is so seldom met with, that even a busy physician sometimes for several seasons does not need to make injections of morphia. The common characteristic of normal cures in Carlsbad is, contrary to the widely circulated view, a rest in the biliary system. If in a number of cases the contrary is accomplished, then these are only exceptional cases, which, especially in cases of occasionally occuring uninterrupted series of attacks of colic, upon being recalled and reported, can easily lead to wrong and exaggerated ideas regarding the effect of our springs. Whatever may be the characteristics of these intervals of rest in the biliary system, they are at least characterized by rarity of severe attacks and complications and by the certainly remarkable fact, that the author during his twenty years practice in Carlsbad had only three cases, where surgical aid was urgent."

There is no discordance between this effect of our cures, to which we must adhere in principle, and the fact, that not infrequently patients, whose attention has once been directed to it, notice excrements of smaller calculi, which are not accompanied by stronger evidences of strangulation. Here we have evidently a simple washing away of these small formations, which is perhaps favoured by a shrinkage and a mucusfreeing of the bile-ducts, but which is certainly not influenced by that vis a tergo of the bile, which does not exist in reality.

The important role, which the liver plays in metabolism suggests the question, as to whether our customary cures might act beneficially in

diseases of metabolism through the intervention of the liver. We have practically no proofs or arguments to offer in defence of such a theory, which, however, does not necessarily exclude the possibility, that in certain cases the removal of a complicating disease of the liver or of the digestive organs by our cure may not be of some service to those disorders of metabolism already mentioned, though the seat of the disease itself can not be reached. The investigation of the mode of attack of salts and salt solutions, which has with such consistency been directed against the disturbances of metabolism, has therefore essentially been carried out in other directions also. Above all, however, was the reigning idea, that a lack of oxydation power must, in general, be regarded as the cause for the appearance of products of an incomplete oxydation in nearly all cases of disturbances of metabolism. This idea, in connection with the conception, that oxydation depends essentially on the alkalinity of the blood, allows us to draw the logical conclusion, that the alkalis introduced must promote combustion processes in the organism and that the increase in CO_2 and urea production would give, therefore, a reliable measure for the supposed increased metabolism. Experiments have not verified this view, as their entirely contradictory results demonstrate. While Münch and Severin were unable to find any appreciable change in the amount of urea under the influence of alkalis, Seegen obtained most striking fluctuations with from 1 to 2 grammes of sodium bicarbonate; however, his method of experimenting was proved by Voit to be wrong. On the other hand, Rabuteau and Constant maintain that they have observed 25 per cent decrease in urea, which, however, they attributed to poor metabolism in the intestine. A confirmation of this view was established by the investigations of Jawein, which were suggested by Stadelmann. Jawein found, that after the administration of sodium bicarbonate and citrate of

soda, which as is well-known becomes oxydized in the body into sodium carbonate, the nitrogen assimilation deceases only, when these act as aperients, i. e. after large doses. According to Jawein the nitrogen change was little altered, in some cases slightly increased. Large doses of these salts caused retention of water in the blood, and did not, therefore, act as diuretics. The metabolism was altered, showing a decrease of the oxydation processes. In the alkaline period a considerable increase in the neutral sulphur of the urine was also confirmed, although at the cost of the acid one, while the intestinal decomposition appeared to remain unaffected. A few unpublished observations of the author gave similar results. In these experiments large doses of citrate of soda were given to a dog, whose nitrogen-metabolism was in a state of balance, and the same indefinite results, namely a fluctuating condition between increase and decrease of the nitrogen excretion, were always found. For their interpretation we need not, however, assume an alteration of the oxydation processes, for these can be explained much more easily by the observed retention of water and the subsequent stream of urine and washing out of the retained sediments, which the organism brings about in a very suitable manner in presence of such quantities of salt. The indirect influence on metabolism of $Na\,H\,CO_3$ in the form of an interference of the salts with the water in the organism has not yet been closely investigated; yet, from the analogy of the action of common salt and sulphate of soda, with which we are better acquainted, this is also very probable in the case of $Na\,H\,CO_3$. With regard to sodium sulphate, Voit found in 1865 — after Seegen had confirmed, that under the influence of this salt the amount of nitrogen was reduced down to 24% —, that like all salts, which show a diuretic action or respectively pass into the urine unchanged, this salt gives rise to a corresponding increase of the nitrogen output. The investi-

gations of Loewy speak also against a principally retarding effect of sulphate of soda on metabolism. He confirmed upon its use an increase in the respiratory products of metabolism and, since the salt itself is incombustible, he concluded, that this increase could only have been produced by the body itself. According to Loewy we have to deal here with an effect, which stimulates the metabolism directly, whereas the increased decomposition is supposed to be effected by the digestive channel. This action must originate from an increased decomposition of fat, since according to Voit the albumen metabolism is not affected by sodium sulphate. That the activity of the intestine is hereby to be regarded as the active moment, is supported by the fact, that Loewy in a repetition of his experiments with sodium chloride and sodium carbonate, which are known not to influence the intestine as sodium sulphate does, was unable to detect any appreciable effect on the decomposition of fat. Although, on the contrary, Salomon recently confirmed with Kissingen water an increase in the necessary supply of oxygen and a correspondingly increased combustion of fat — which in an experiment of three hours' duration could be calculated as being 2,3 and 1,7 grammes of fat respectively —, this speaks for Loewy's interpretation of the effect of sodium sulphate, in so far as the sodium chloride water of Kissingen obviously works more stimulating on the intestinal mucous membrane than simple sodium chloride solutions do.

In a later series of experiments on a castrated bitch feed daily with 3 grammes of soda Loewy found the interchange of gases increased about 30%, whereas in a following series he failed to detect any effect.

The experiments of Mering and Zuntz confirm Loewy's interpretation of the effect of sulphate of soda; they regard the increased consumption of oxygen upon the administration of food as due chiefly to the work done by the digestive organs.

The same diversity in opinion is met with sodium chloride with regard to its behaviour towards albumen metabolism as with $NaHCO_3$ and Na_2SO_4. The assumption first made by Voit, that its influence on the albumen depends chiefly on the diuretic effect, seems to be confirmed by the more recent observations of Straub. Straub was able to prove, that sodium chloride given in small doses decreased the decomposition of albumen, as long as no increase in diuresis was detected. With medium and stronger doses an increase in the decomposition apparently took place, which, however, depended only on the simultaneously increased diuresis. For, if at the same time water was given, there was no increase, but rather a slight decrease in the decomposition of albumen. This effect of water abstraction has been established by experiments, which were made especially for this purpose, as we shall see later on. In our cures the water abstracting effect of the salts is seldom of importance, since the salts are generally taken with comparatively large quantities of water. The diuretic and sometimes also the diaphoretic effect of these cures is sometimes so strong, that the water-balance for the body may in some cases be negative. The fact, however, that there is no loss of albumen caused by the abstraction of water, is to be regarded as an advantage rather than a disadvantage of our cures.

v. Noorden and Dapper, who made observations on metabolism upon the use of Rakoczy and bitter water and found no increase in the decomposition of albumen, point out as an advantage of such mineral water cures, that they leave the protoplasmic substance undisturbed; according to Brandenburg the same is the case with Carlsbad water.

At the time, when the abstraction of water was regarded as the chief factor in the treatment of obesity, the supply of water prescribed by our cures had to be considered as an obstacle to the combustion of fat.

As, however, nowadays all expectations associated with water removal with regard to the consumption of energy are entirely abandoned, we may as well assume that, even if the salts of our waters had an influence on the decomposition of fat, this would certainly not be checked by the water itself. On the other hand an objective critique of all investigations carried out up to date must convince us that the general oxydation processes themselves offer no foundation for the fact that our salts may be attacked, apart from the practically unimportant fatconsuming influence of the sulphate of soda on the function of the intestine. Though further investigations may lead to new points of view, we should not place our expectations too high as we do not need by any means to take too seriously the failure of our expectations about the unsuccessful proof of the assumed effect of the salts. The supposition, on which this proof is based, in that it ascribes the appearance of sugar in the urine and of uric acid in the blood as well as the morbid deposit of excessive fat to a decreased oxydation energy, has been a capricious one and is, according to the present view, already partly abandoned. It appears least justified in the case of diabetes according to the experiments made by Voit, Pettenkofer and other experimenters in Voit's laboratory, as well as by von Mering and others, who have not found the decomposition of albumen or the absorption of oxygen and the production of CO_2 of diabetics to differ from those in healthy patients. Moreover, we have seen above in the investigations of Magnus Levy already mentioned that the influence of alkalies was rather in the opposite direction, and that in severe cases of diabetes they give rise to an increase of the less completely oxydised acids and especially of the acetic acid, though this phenomenon was also interpreted as an increased washing-out only. If nevertheless, we cannot dispense with alkalies in the treatment of these conditions, it is certainly not on

account of their influence on the oxydation processes but because they render the accumulating acid products of diabetic metabolism voidable in the urine, alkalinising them, and thus freeing the body from poison.

The output of sulphuric and of phosporic acids upon the use of alkalies appears to differ but little from the normal.

An interpretation with regard to a real, i. e. a reducing, influence of the energy of metabolism could be upheld must easily in the case of the disorders due to morbid obesity. However, von Noorden and Magnus Levy, whose experiments on a number of obese persons confirmed a decreased oxygen absorption and increased CO_2 delivery per unit of bodyweight, pointed out themselves that similar values for O and CO_2 could, under certain circumstances, be obtained with persons who were not obese. On the other hand, Rubner prooved by means of an accurate estimation of the entire receipt and expenditure that marked obesity can even be accompanied by an increased energy of decomposition of the protoplasm. Von Noorden makes use of the hypothesis of a decreased oxydation power only for those cases of excessive obesity which are frequently of an hereditary nature, and in which it is generally impossible to produce any considerable diminution by limitation of the supply of food.

In the case of gout considerable fluctuations in the secretion of nitrogen have been actually proved by Vogel, Schmoll, Magnus Levy and Lacquer. Yet these seem to be connected less with fluctuations in the decomposition of albumen than with the retention of nitrogen. Magnus Levy was able to detect in gout no variation from the normal with regard to the respiratory metabolism. If, on the other hand, Treskin, Stadelmann and Ken Taniguti, the latter in Salkowski's laboratory, all agree in their observations that alkalies reduce the formation of uric acid, this can only be explained so,

that by their use the uric acid can in an increased degree be led to combustion, while at the same time the entire nitrogen metabolism obviously need not undergo an increase.

The resignation, which is due to the insufficiently positive results of the investigations made up to date with regard to the immediate influence of salts on metabolism, is supplanted by a more satisfactory comprehension of their action, if we do consider metabolism not to end with the purely chemical process of combustion, but to extend also to the mechanical process of the removal of the final products of decomposition as well as to the production of new materials in the place of combustion, i. e. in the cells. The organic salts supply, as we have already seen, a part of the force acting for the transport of this material, which apart from the influence of the circulation is accomplished by the laws of osmosis and diffusion. In this way the salts are to a certain degree also determining factors for the motive and the exchange of the water in organism, an influence which is greater, the more the salts change the whole water condition of the organism, thus causing indirectly an increased disintegration of materials, as has been shown in the discussion on the effect of sodium chloride and sodium sulphate upon the decomposition of albumin.

The intimate connection between the action of salts and that of water directs our attention to the question as to what share the water plays in our cures and what we may expect from the action of the water alone. Its influence interests us with regard to both limited and increased supply. It interests us with regard to limited supply, since the wrongly presumed advantages of limited supply of water should be resented, at least as far as they could serve to throw any reflection on the value of our cures on account of the supply of water demanded by them. As a consequence of the popular cures of Oertl and Schweninger, who

tried to bring about an increased combustion of the body fat in the obese by limiting the supply of water, a large number of such experiments have been made, the results of which agree comparatively well with one another. Upon a complete withdrawal of all liquids the amount of urine falls to a minimum; the tissues become drier and the nitrogen output increases in general, decreasing only in some cases during the first few days of the cure in consequence partly of retention of nitrogen and partly of delayed absorption from the intestine. Later there is evidence of a progressive increase in the loss of nitrogen, in some cases in a more marked degree in the later periods of the cure. The stronger and the more rapid the desiccation, the greater the disturbance of the nitrogen balance. The expected increase in the fat combustion however, corresponds in no degree to this increased destruction of albumen. In a series of unique experiments on dogs Straub found no change in the output of CO_2 during thirst, as compared with that of the periods before and after; and it has been established beyond all doubts in von Noordens clinic that an increase in the oxygen consumption does not take place in chlorotic and obese girls before and after the periods of thirst. The theoretical speculation, on which the above mentioned cures are based, is also entirely disproved by facts; they do not accomplish what they should, and with regard to the albumen metabolism, exactly the opposite of what is sought. Moreover, a temporary abstinence from the water supply, as prescribed by Schweninger at meal times, has no effect on the amount of absorption by the intestine, and, according to Spiegler, no influence on metabolism.

Of greater importance for our purposes than even the influence of diminished water-supply is the question as to how metabolism is affected by increased reception of water. On this point information is to be had from a series of excellent investigations by Bischoff,

Forster, and especially Voit, who have conformed a loss of nitrogen up to 25 per cent. While Voit interpretes this as an increased destruction of albumen, most of the other authors, including Bidder and Schmidt, Salkowski, Munk and J. Mayer, attribute this increased nitrogen loss solely to its being washed away. The latter conception is supported by the later researches of Oppenheim and especially by those of Neumann. Von Noorden was also able to confirm in his experiments only a shortly lasting washing away of nitrogen, which he failed to detect, when more water was given before the experiment. It thus seems that the increase of nitrogen, which appears in the urine under the influence of water, would depend on a washing away of albuminious sediment and not on a destruction of albumen, the recent investigations of Heilner in Voit's laboratory appear, however, to support Voit's original conception, and to reconcile the opposite views, for they establish the fact, that the excessive withdrawal of nitrogen after supply of water occurs only in starving animals and that this is to be regarded as an excessive decomposition of the nitrogen-containing substances in the body, as is evident from the simultaneously observed behaviour of the chlorides.

The effect of continued flushing with water on the physiological consumption of fat has not been much investigated. Latschtschenko found no change in the CO_2 output during such experiments of four hours' duration. In diabetes mellitus and insipidus, where under certain conditions large quantities of water flow through the body, most authors have found no change in metabolism. Even the energy to be expended in the heating of such large quantities of water can evidently be automatically compensated for by a change in the loss of heat through the skin. The experience of breeders, according to which plentiful drinking is disadvantageous to fattening purposes, indicates the importance of water in the consumption of energy.

In order to fill up the gaps which still exist in our knowledge of the action of water we recall the most recent investigations of H e i l n e r, which distinctly show an influence of water also on the destruction of fat analogous to that on the albumen. From similar experiments on respiration the increase in the fatcombustion appears on the average to amount to 9 percent on days, on which water is taken. Here, too, the effect is a conditional one, as is in the case of the destruction of albumen, for it takes place only during the state of starvation of animals i. e., under conditions, where the wather supplied is, as it were, superfluous for the body, since the starving organism secures sufficient water for its needs from the destruction of its own substance and does not require a supply of water. This abundance of water disappears, however, as soon as the animal is fed and the water supplied to the body fulfils a physiological purpose, as is for instance the case, when a certain quantity of grape-sugar is added to the water, or when the animal is subjected to higher temperatures of low humidity in which cases the water supplied has to replace that loss of water. We can thus maintain that water, if supplied in abundance, develops a specific dynamic action upon the entire process of decomposition just as the energy-supplying nutriments do, for, although it does not supply energy itself, it brings about the decomposition of the food. As to how and why the water plays this part, there is certainly a lack of definite proofs, and only opinions are at our disposal. Of the latter that held by V o i t cannot at present be replaced by an any more plausible one. According to Voit a copious supply of water increases the circulation of the intermediate substances, promotes the flow of lymph, and thus increases metabolism. A washing away of the metabolic deposits is also accomplished by the action of the water; this, however, is not the object, but only the means of that action, since it promotes the formation of deposits in a chemotaxic

manner by stimulating cell metabolism through a more rapid removal of the metabolic products and reception of fresh combustible materials. For practical purposes Heilner concludes from his experiments that the decomposition of fat must increase, also in the case of no bodily work on the part of the person experimented with, provided he drink water in the fasting state and then fast as long as possible in a room kept at a medium temperature and in a condition of absolute rest. The future will show to what degree this theory may be developed as a method for the treatment of corpulency. Many experiences can easily be accounted for from this new point of view, such as, for instance, the fact that our cures sometimes produce unexpectedly good results, as with corpulent persons, who acting either on medical advice or on their own responsibility drink large amounts of water. At all events this new theory, based on the action of water, is, together with the therapeutically important fact that, as von Noorden and Dapper proved, the obese person contends with the dietetic restriction of the supply of calories as long as possible more or less exclusively by means of his own fat and only in extreme cases with his albuminous material, well suited to reestablish the faith in the cures for the reduction of obesity by means of our mode of treatment.

The obvious objection that such effects of water are not at all confined to the mineral waters is annulled by the fact that the mineral waters of the composition of our Carlsbad hot springs are the very ones that guarantee these effects in the most certain and most practical manner. In order to understand this, we recall only the previously mentioned merits of the salt contents of our waters, which cause their rapid passage from the stomach to the intestine and their rapid absorption there. It was also the salts, especially the sodium chloride and sodium bicarbonate, both in

the blood and in the intermediate fluids, which, being as it were the essential physiological mineral substances of those fluids, enabled a sojourn of proportionately large quantities of water in the organism, without causing too great a change in the osmotic pressure, which would be prejudicial to the integrity of the cell. Both salts possess, moreover, in sodium sulphate an attendant, the diuretic qualities of which complete the effect to a total effect, which indeed predestinates our waters for the irrigation of the tissues; the diuretic qualities of this attendant will be considered below. As to the direction, in which the changes in the molecular concentration of the blood tend, this depends on the proportion of water to salt and on the length of time prescribed by the cure they are retained in the body, and indirectly on the strenght of the heart and function of the kidneys. Theoretically an increase as well as a decrease in the osmotic pressure is conceivable. If our above hypothesis is correct an increase in the molecular concentration of the blood due to our cure would be accompanied by attacks of gout, where as a diminution of the same would manifest itself in the action of hypotonic solutions of sodium chloride in cases of nephritis. Schönborn, as is well known, prescribes hypotonic solutions of sodium chloride on the ground of his kryoscopic investigations, from which he draws the therapeutic conclusion, that in cases of increased concentration of the blood we should combine the popular sweating cures with the application of these salt solutions. He hopes in this way, assuming of course a good functional capacity of the heart, to bring about prior to sweating an attenuation of the blood by inundating it with fluids of lower molecular concentration and to produce by means of the subsequent sweating a greater output either of deposit or of toxines, without endangering an inspissation of the blood. Aside from the restrictions imposed upon every

form of treatment of nephritis, due to the variable action between water and salt and that of deposit retention, of the hypotonic waters our springs evidently come into consideration for all purposes of purifying of the blood, especially as they exercise a specific effect upon the kidneys through the diuretic action of their sulphate of soda. For our knowledge on this subject we are especially indebted to M a g n u s, from whose observations on the influence of isotonic and hypotonic salt solutions on the kidney secretion we gather that the blood can withstand relatively large amounts of the former, whereas it seeks to get rid of the fluid more quickly, when hypotonic solutions are introduced. According to M a g n u s the osmotic pressure of the blood is altered either inappreciably or not at all by the introduction of isotonic solutions, whereas it is greatly lowered and for several hours by hypotonic solutions, and correspondingly increased by concentrated ones. Upon the introduction of the latter water passes out of the tissues into the blood, and salts pass out of the blood into the tissues, whereas upon the introduction of hypotonic solutions water passes more quickly than salt into the tissues. The fact that the blood carries off into the tissues a smaller portion of isotonic than of hypotonic solutions is explained by the lack of any difference of osmotic pressure on the two sides of the vessel membrane. The diuresis that occurs after isotonic solutions takes place under nearly constant osmotic pressure, after hypertonic solutions under increased and after hypotonic ones unter decreased pressure. The most important fact to be gathered from these investigations is that a high degree of diuresis is consistent with a considerably lowered osmotic blood-pressure. S t a r l i n g even found that the only change that was always produced by all salt diuretics was a thinning of the blood. On the assumption of von H e i d e n h a i n, L i m b e c k and M ü n z e r, according to which the diuretic action of the salts is pro-

portional to their power of attracting water, we should expect that isotonic salt solutions, which cause a similar thinning of the blood, would also produce the same diuretic action. As a matter of fact, however, this is by no means the case, for M a g n u s obtained with isotonic solutions of sodium sulphate twice as powerful a diuresis as with solutions of sodium chloride. Contrary to L i m b e c k 's and M ü n z e r 's assumption sodium sulphate proves itself to be diuretically more effective and even more capable of excretion than sodium chloride. The excretion of sodium sulphate is therefor correspondingly greater than that of sodium chloride, whereas the thinning of the blood is the same for both salts. The greater diuretic action of sodium sulphate is probably to be explained by the fact that the kidneys are more permeable for sodium sulphate than for sodium chloride, while the reverse is the case with the intestine. The kidneys are adjusted for a given salt contents of the blood; as soon as a single constituent part of this contents is increased, it is removed by the kidneys, and it is really the dilution of the blood, which in consequence of an active vascular dilation produces diuresis.

The diuretic action of our springs also indicates the way, which water and salts, in so far as they do not pass through the intestine unabsorbed or reach it by way of intermediate circulation, take on leaving the body, at least under normal conditions. Whether the skin plays a part as an excretory organ for our salts, we do not know, inspite of the empirical facts, that sweat is always accompanied by sodium chloride and that our waters excite diaphoresis, sometimes even to such a degree that both the intestine and the kidneys suffer under that effect.

6. Effect of the Carlsbad Baths.

Our above considerations would not be completed without reference to the b a t h s. They form in most cases an integral part of the therapeutic measures of

our cures, though their importance is generally only secondary compared with the drinking-cure proper. As to the effect of the different baths so much has been written on the subject, that it is hardly necessary to deal with it here at length, especially as our baths have no specific advantage over those of other places, although they are by no means inferior to them. This can be maintained particularly of our mineral or Sprudel and mud baths. The former owe their properties and effects to a dilute salt-solution, while the latter may be compared to advantage with the best recognised mud baths. Among the effects attributed to these as well as to other baths the interest of the physicians has been directed chiefly to those on the nervous system, on the blood-pressure, as well as on the distribution of the blood and on metabolism. The extraordinarily great individual difference in the reactive capacity of the skin and in the circulation- and heat-conditions of the organism with regard to the thermic and chemical stimulation produced by a bath excludes a uniform effect of the different baths. Thus we have found under their influence the metabolism and blood-pressure to be increased in some cases, and to be lowered in others. Many contradictory results could probably be explained in the simplest manner by the different effects of various bath-procedures upon the water-conditions of the organism. We could understand, how hot and cold baths could produce the same results with regard to the processes of decomposition of materials, though in different ways, since in the one case the withdrawal of water and in the other that of heat would cause an increased metabolism. The effect of the bath resulting from the balance between temperature and water can obviously be modified very considerably by the nature of the bath itself. — It is also clear that hereby the osmotic pressure, which the bath exercises on the impermeable membrane, that is, on the skin of the bather in its capacity as a heat regulator, can play an important

part. Thus the concentration of the bath in consequence of a change in the reaction of the skin should manifest itself not only in the heat-balance, but above all also in the behaviour of the blood-pressure and the activity of the pulse. — A similar explanation can be offered for the fact that, according to Loebel, highly concentrated mud-baths are an exception to the general rule, according to which the blood-pressure and activity of the pulse are increased by cold and decreased by warm baths, while in baths of 40° C an increase is experienced in both, which however after one half to two hours is followed by a gradual decrease.

The influence of the baths on the distribution of the blood and on the water-balance probably causes changes in the osmotic pressure of the blood itself, and has accordingly led to the result that the effects of the baths are now considered from this point of view. According to Hughes this pressure is increased by mineral baths, and decreased by fresh water ones. The accelerated absorption of exudates and transudates after mineral baths could to a certain extent be satisfactorily explained on the assumption of such a change in pressure, especially if we consider that the osmotic pressure of such exudates, as far as we know, is about isotonic with that of the blood. Thus small changes in pressure would be capable of bringing about an absorbent exchange between such inert quantities of exudates and the blood.

The influence of baths on the alkalinity of the blood and urine, which according to Strasser is such, that cold baths make the blood alkaline and the urine acid, and hot baths both blood and urine acid, is, in consideration of the mode of application of our baths, of much less importance than the corresponding effect produced by our drinking cures. Recently an attempt was made to make use of the electric conductivity of the mineral waters in bathing cures, attributing to it a special agent for the body. Such speculations, however,

founded on the belief of a special action possessed by a bath with high electrical conductivity, do not appear to be able to stand serious criticism.

To meet a demand of the times and at the same time a very frequently existing indication for our patients, our Sprudel baths were often transformed into carbonic acid baths by the introduction of CO_2.

CHAPTER VI.

Indications for the Use of the Waters in Carlsbad.

The indications for the application of our springs have already been pointed out in the above discussions, and we can surely conclude from what has been said, that, wherever a correction of existing conditions or disproportions in the human body appears possible at all by means of the described effects of the salts, they are in principle destined to act as a remedy. If, on the other hand, other springs have in the course of time proved more effective in certain classes of diseases than those of Carlsbad, we do not intend to doubt this, as long as a reasonably objective experience justifies this preference. If, however, this is founded on a doubtful basis or on prejudice, then it requires direct and decided contradiction. Such a prejudice is the proverb of the danger of the Carlsbad springs. There were, perhaps, times, when our waters contained certain dangers in themselves. In our modern method of cure, however, this no longer exists; and indeed one might regard the often exhibited timidity and discretion in the use of the waters rather as an impediment to our cures. Those, of course, who identify the positive effects of our cure with danger, probably consider Carlsbad the most dangerous of all baths; especially the laity, which suspects everything, that does not turn out as it wishes it, or does not quite come up to its expectations. As a matter of fact certain surprises and disappointments are not to be excluded from our cures, in consideration of their manifold effects. Since their total effect is, as it were, a combination of a series of individual effects on the stomach, intestine, circulatory organs, kidneys, and skin in various degrees, the subjective feeling of

the patient is that now this, now that organ is brought more into prominence, whereas his conditions of health are subject to such symptoms of discomfort as pains in the stomach, intestinal colic, diarrhoea and constipation, headache, congestion, vertigo, palpitation, insomnia, profuse sweating, irrestible strangury etc. Owing to the dependence of the total effect upon so many factors and especially in view of the lack of a definite basis for the therapy of our salts, it is at present impossible to apply our salts and waters in such a way, that their effect may be confined alone to a certain organ and in the degree desired; nevertheless such an application is always more or less possible, and the undesirable effects can often be reduced to a minimum. Like every medicament, mineral waters also can by prudent use or by abuse become either a good or a bad implement in the fight against disease. Although the question, as to how much and how often, how cold and how warm, and when, waters should be taken, requires as little inventive genius as the prescription for a cough or sleep remedy, their application should be studied, exercised and practised, if they are to aid the sick to the greatest possible extent in the shortest time. The physicians at our wateringplace consider this as their serious duty and in their name I request here that every cure under all circumstances should be supervised and directed medically on the spot. Apart from trivial considerations of a material nature, — though they stir the medical world very deeply — we make these requests in the first place in the interests of the patients, further in the interests of the watering-place, and not least in the interests of medicine itself. Daily experience proves to what results cures carried out on one's own responsibility or according to the prescription of a family physician often lead: very soon the boat begins to wave on the unstable stream of the Sprudel and re-

quires a stronger hand to steer it, be it, that unexpected disturbances render this necessary or that a latent condition suddenly becomes manifest and demands urgent medical assistance. That such a compulsory acquaintance between physician and patient is really not desirable and that in this way controversies between the family physician and the physician at the watering-place as regards their opinions are not treated with the usual delicacy of feeling, is only too conceivable. — It thus happens that medical prestige often suffers under such situations.

Inseparably connected with a proper application of the specific remedy is evidently a diet mapped out according to the needs of each individual case. It was also the incessant endeavour of the physicians of Carlsbad to have this recognized in all circles. The quite meaningless idea of the term "diet according to the cure" in our modern acception of the phrase leads even now to many mistakes. Nevertheless the diet on the whole is in a great measure taken into account and much is expected from a wider consideration of the food conditions.

On the assumption of a proper application of all the remedies at our disposal we can expect the Carlsbad cures to lead to good results in the cure of the following diseases:

1. Diseases of the Mucous Membrane of the Stomach. In the first place acid catarrhs, especially the catarrh of the drunkard. Our waters act here as anticatarrhal agents, as antacids; and besides have a soothing action on accompanying pains. In consequence of their hypotonic nature they leave the stomach comparatively quickly and are accordingly indicated also in conditions associated with atony, and, when taken cool, in simultaneous atony of the intestine. — Upon removal of the catarrh they can bring about an increase of

acid in cases of catarrh associated with diminished hydrochloric acid.

2. **Gastric Ulcer** on the same grounds as catarrhs, partly through an influence upon the possible catarrhal condition, and partly by removal of the pathologically disordered secretion. In ulcers, which have a tendency towards haemorrhage, the cure should not be undertaken until sometime after the haemorrhage.
3. **Nervous Dyspepsia**, dyspepsia associated with functional disturbances of the stomach. As to the suitability of our cures in these conditions opinions differ. Although it must be admitted that our expectations in such cases are not always fulfilled, the application of our cures can be recommended, because behind such disturbances may lie hidden many causes, which certainly baffle objective proof, and yet are accessible to the influence of our cures (cholelithiasis etc.).
4. Among the **Diseases of the Intestine**, catarrh is specially adapted for treatment in Carlsbad. In fact we might place this indication at the top of the list, for we believe that the washing of the intestinal surface, which is aimed at, cannot be better accomplished than by means of the solution of our water changed into a physiological solution of sodium chloride, as we have already shown. Above all **Diarrhoeas** are suitable indications, whether they be primarily the result of catarrh or due to the exciting effect of constipation in the sense of foecal retention diarrhoeas. The effect on chronic constipation is less certain, but it is most sure in the form known as spastic constipation, in which the antispasmodic effect, that is the "opiate action" of our hot springs, has often produced marvellous results. Our cures are variable in their results on common disturbances of the

large intestine such as membranous inflammation, because in this case the secretion appears to be effected to an incalculable degree by the nervous system. A trial of our cures is therefore also to be recommended in such cases on account of lack of other more definite methods of treatement before all other mineral water cures.

5. **Catarrh of the Coecum** and the **Catarrh of the Appendix** associated with it, the result of the exudates from a preceeding appendicitis, can be cured by the combined use of the baths and the waters. This is an old experience.

   Good results have been observed in numerous cases of diseases of the intestine referred to by the application of our waters in the form of momentary and continuous enemata.

6. **Catarrhal Jaundice**, due to the nature of its origin, unquestionably belongs to the sphere of action of the Carlsbad springs.

7. The most excellent results obtained in **Hyperaemia** of the **Liver** have already been referred to. They are due to the more accelerated flow of blood in the organ caused by our salts, with which is associated as a healing agent the derivation of blood on the intestine so produced.

8. **In Tissue Changes of the Liver (Cirrhosis)**; although no healing action is produced, a cessation at least in their development as well as a maintainance or improvement in the function of the organ is accomplished, as long as the condition itself does not lead to extensive dropsy.

9. **Cholelithiasis** as far as it can be regarded as an object of internal medicine. We have already explained, in what way we imagine the influence of our springs as beneficial in this disease and what can be obtained from their use. What has been actually achieved has been so often repeated in words and in writing and in such persuasive

terms, that one can maintain that the internal treatment of cholelithiasis is identified with the healing principles embodied in the Carlsbad cure. Since no other form of treatment can point to such traditions and none satisfies the many-sided pretentions of therapy to the same extent as the Carlsbad cure, the latter may safely assume the treatment of cholelithiasis as its own domain. The fact alone that every year about 15 000 sufferers from cholelithiasis seek recovery in its springs or at least relief from their sufferings speaks conclusively. The value of the Carlsbad cures for cholelithiasis may also be regarded as certain as far as a criticism is concerned, which does not count but weighs the votes. There is, moreover, scarcely a clinical textbook or a treatise of importance referring to the treatment of this disease, in which the Carlsbad springs are not named before all others. Among the numerous illustrious physicians, that have referred to Carlsbad in this connection, we mention here only Naunyn. Prominent surgeous, among others those, who make a speciality of gallstone-surgery, are unanimous with physicians to-day in their praise of the internal method of treatment as carried out by us, naturally with full recognition of their own surgical claims, of which most physicians in these days approve. It thus happens that our most renowned surgeons before they actually proceed to an operation on gallstones, send many of their patients to Carlsbad for the cure. The New York surgeon Beck, in the collection of clinical reports by F. Müller and Fr. v. Winkel, remarks in an essay on cholelithiasis, which is as striking as it is humorous: "A cure at Carlsbad is very much to be commended. The person, who has not the means to get the Mühlbrunn at the spring, can also obtain the Carlsbad principles at

home. I have seen many patients recover under this treatment, who already appeared to be ripe for operation. Moreover I know many a colleague, keen on using the knife, who as soon as his own gallstones began to depress him, preferred to let his life's tow-rope be washed in the Sprudel instead of placing it on the edge of the knife."

The very praiseworthy task of determining the results of the Carlsbad cure statistically has been likewise undertaken by a surgeon named Fink; and by means of an enquiry into the cases healed by him internally in his practice for a number of years he found that in 80% of these cases latency of gallstone symptoms was recorded after the use of the cure.

As a sign of the favourable influence of our cures on cholelithiasis and its consequences the facts recorded by Ritter ought to be referred to here. He met with no single case of death out of a total of over 4000 cases of gallstones treated by him within the last twenty years, and the mortality from cholelithiasis in Carlsbad did not exceed 0,078% of the patients suffering from gallstones, including those, who died after operation (viz. 0,026%).

10. Under the heading of diseases of metabolism Gout occupies the first place as an indication for treatment by means of our springs. We have already attempted to explain the mode of action and also the manifold phenomena of our cures by a somewhat plausible theory, the weak points of which we know very well. Nevertheless the principle of treatment underlying our cures, in as far as it tends to the alkalinisation of the tissues and removal of deposits by the kidneys, agrees with all the theories specially expounded for the problems of gout, whether we assume as Minkowski that uric acid is retained in loose combination in the

blood or that a primary insufficiency of the kidneys for uric acid excretion determines the nature of gout.

11. That the **Uric Acid Diathesis** is directly combatted by means of our cures has already been referred to above.

12. We have given above a few views on **Diabetes Mellitus**, from which it seems that a favourable influence could be exerted by our cures on the course of this disease. Nevertheless we cannot conceal the fact that these cures are less supported by a scientific argument than by an old and well founded experience, on the ground of which physicians as well as patients stick to the principles of treatment prescribed by our cures. Aside from the rather vague but nevertheless by no means immaterial objection, that owing to the great variability in the composition of our mineral water (radium emanates completely in a few hours) observations made on the spot can alone be considered conclusive, we must admit that as regards the question of the influence of our cures on diabetes two facts stand in direct opposition to each other: on the one hand the fact that the sugar-combustion cannot be appreciably altered under the influence of our water, and on the other hand the actual experience that many diabetics become free from sugar in Carlsbad, while they do not achieve this at home under the same conditions of life and under unprejudiced personal or medical control. It appears to us, as if in this respect diabetes, when combined with gout or uric acid diathesis or with obesity, have better chances of recovery, and as if also in such cases the symptoms of an increased tolerance for carbohydrate under the influence of our cures could be better observed. A trustworthy summary of our ex-

perience in the treatment of diabetes shows that, aside from the many favourable results achieved, there are many cases, in which the treatment fails. There are cases, in which, ceteris paribus, the excretion of sugar is increased under the influence of the cure, so that all attempts must be abandoned at once. Such cases are chiefly those of nervous diabetics, whose sugar-excretion is appreciably increased upon the least excitement and upon every step out of their usual course of life. Such people, as well as severe cases, especially diabetes in children, are not always suited for Carlsbad, though we do not go so far as to exclude from the cure the diabetes of all young people.

13. The combatting of Obesity also has always had a specially good hold in Carlsbad. While up to the present we were accustomed to attribute the value of our antifat treatment almost exclusively to the deprivation of food caused by the purgative action of the water and of the Carlsbad salts, we have come to recognise in the oxygenating power of the water, under certain conditions, a new effect, which the attempts of our cures to reduce fat are able to achieve. Retrospectively our supposition is directed to the latent cooperation of influence of the latter kind often caused by an evident tendency towards decrease in bodily weight, which often appears also in the course of or in connection with our cures, where one would intentionally avoid loss of weight or even try to achieve an increase in weight. It cannot be denied that from such tendencies sometimes difficulties result, which may seem to those of little experience rather dangerous; while in other cases of obesity, as already mentioned, all our endeavours with regard to reduction of fat are absolutely of no avail.

From the above mentioned peculiar behaviour of the body-weight the frequently doubted fact

seems to become apparent that the so much praised after-effect of our cures is indeed no mere fancy, no cheap consolation for a better future. — It is those apparently unexplainable losses of weight, which sometimes continue throughout weeks and months and manifest themselves as a sort of tendency of the cells of the body to remain constant, which v. Leube described in connection with the disturbances of metabolism and the processes of immunisation against infectious diseases as being a work of the cells. Also with these conditions, as v. Leube assumes, there is a definite power of persistence in the working of the cells to continue in the direction once assumed, irrespective of whether it be a wrong one or the one desired. In our cases this power of persistence would become evident in the continuance of an increased combustion of fat, to which the cells of the organism are induced by a stimulation of the intermediate secretions through water and salts.

14. Among the diseases of the **Urinary Apparatus**, which can under certain conditions be treated by our cures, we have already mentioned nephritis, and might also in view of the prominent rinsing quality of our waters extend this claim to all catarrhal diseases of the urinary tract, especially if the drinking-cure is aided by suitable local treatment. The prostate too, sympathetically affected by disease of the urethra, does not appear to escape the influence of our drinking-cures upon the glands and mucous membranes. At least some already forgotten cases of gonorrhoea, which under such conditions suddenly become active again under the influence of our cures, may by regarded as infections by mobilised germs. We believe, therefore, that the most essential effect of our cures in disease of the urinary organs should be attributed to the prophy-

laxis of threatened formations of calculi, which result from the uric acid diathesis and the oxaluria present. The endeavours, called utopian by Ritter, to dissolve in the chemical sense calculi already formed have as a matter of fact recently found advocates, yet we think that the influence of those cures is chiefly restricted to a support of the mechanical decomposition of calculi or, what is certainly more frequently the case, effect of a washing away and expelling due to the increased urinary flow.

15. Among the diseases of the **Nervous System** Neuralgia, which is associated with **Gout** and **Diabetes**, ought to be recommended for treatment in Carlsbad by drinking the waters and taking the baths.
16. **Diseases of the Skin**, as far as they develope conditions accessible to our cures, are most satisfactory objects, just as the root of the evil itself is, for treatment by our cures, of course under a suitable local treatment.
17. Under the head of **Infectious Diseases** come the sequelae attendant on **Malaria** and on **Dysentery**, which are at least very favourably affected by our cures.
18. For the more or less exclusive treatment by our baths must be considered those **Diseases of the Female Sexual Organs**, which are suited for treatment by baths; so too, diseases of the joints and muscles, which are accessible to this form of treatment.

We need scarcely refer to the fact that all the known conditions of disease cannot form the object of treatment with our waters at any price. It has therefore always been desirable to compare the indications with the contra-indications in order to suggest that in certain complications and combinations of diseases the results of cure would be rather doubtful and in fact the whole attempt hazardous. By desisting here from the

usual enumeration of the contra-indications we are of the opinion that there is scarcely a condition, which does not admit of a carefully considered use of our cure, in as far as an advantage or only a consolation to the patient is to be hoped for. The seriousness of the disease can alone decide the question as to whether the patient should be removed from his home, exposed to the troubles of a journey and finally set down in a strange place. These things are not, of course, subject to rules, though, according to experience in cases of malignant tumour, severe anaemias, compensatory disturbances in the circulatory system, tendencies to haemorrhage of all kinds, tuberculosis etc., we refrain from advising to send the patients to our springs, in order to avoid disagreable consequences. A less difficult, but at the same time very frequent decision has to be given concerning the question, whether one could expose nervous patients to our cures and to the restlessness of the life of a watering-place. We answer this question in the affirmative, advice that for such patients only the early spring and autumn should be chosen as the seasons, whose climatic qualities renders Carlsbad suited to such patients as a health-resort. — Nervous patients will be able to enjoy their stay in Carlsbad quite undisturbed, when once the administration of the health-resort will have succeeded in their very energetic endeavours for decentralisation, which is the only possible basis for the social life of the patients, as well a for the silencing and simplification of the traffic. Above all when they have rendered easy of access the neighbouring woods and heights to the infirm and those requiring rest, and so made the therapeutic remedy of nature accessible to them. Carlsbad, then, can with pride call itself a great natural healthresort, having of course nothing in common with those, who monopolise the so-called natural remedies for unauthorised and selfish business-purposes and thereby bring them into discredit. For the genuine balneotherapy has always aspired to

and expected its promotion from medical science. Carlsbad has always placed the gifts of Mother Earth, which here reveals her inmost and has produced a truly divine apothecary in the spirit of a Paracelsus, at the service of medical science, so that the latter may distribute them to the welfare of humanity.

It has been our endeavour to lay before the representatives of medical science, that is, the medical men themselves, the ideas and conceptions, by means of which a physician of our times can use that wonderful work of nature for his purposes.

CHAPTER VII.

Walks and Excursions.

In addition to the splendid gift, with which Nature has blessed Carlsbad, there is a belt of beautifully situated woods surrounding the whole valley and stretching far beyond the neighbouring mountains. The splendour of these woods have had numerous admirers at all times, among whom we may mention Goethe and Schiller. In order that this unparalleled possession might be properly appreciated by the public, the unceasing labour of many friends of Nature has rendered these thick woods accessible. To the town administration rightly belongs the great merit of having extended the woods by constantly buying up new tracts and of having preserved them by rational management from destruction, so that Carlsbad possesses to-day nearly 3,375 acres of actual wooded parks with promenades and views, such as cannot easily be found in other watering-places. Unfortunately these beautiful natural pleasure-grounds are only accessible to a small number of the patients at this health-resort, since the ascent to these wooded heights is somewhat labourious. On the top there is a level promenade. The erection of elevators will do away with this evil, and will fulfill a long felt want. Promenades lead through our woods in all directions. They are dry and free from dust and their total length amounts to 90 kilometres, whereas several points of view are easily accessible by the forest pathways, the total length of which is 30 kilometres. Thus the stranger can daily wander for hours in the woods, without having to repeat his walks even upon a longer stay in Carlsbad. An innumerable number of sign-posts prevents going astray. Only those visitors to Carlsbad know how to appreciate its charms

fully, who are able to avail themselves of all the pleasures of the magnificent and quiet grandeur of these woods.

Of the great number of outlooks and spots in the woods, to which a visit can be specially recommended, we mention here only a few. On the left bank of the Tepl directly behind Hotel Pupp, begin the promenades leading into the neighbouring woods, which ascend in zigzags the steep mountain slopes to the Franz Joseph Summit (507 m above sea-level) or to Friendship Summit (525 m above sea-level), and to Findlater's Temple, so-called after Lord Findlater, an admirer of Carlsbad, to whose memory the town erected a memorial stone in the woods so much beloved by him. On the level road above one reaches the "Hirschensprung", whose sharp mass of rock projects like a landmark towards Heaven. From the isolated rock, which can easily be seen from the town, one enjoys a beautiful though not extensive view of the deep-seated valley with its houses. The legend runs that the hunted deer jumped from this rock into the valley, at which spot in the dense primeval forest Emperor Charles at the head of his hunters discovered the hot spring.

Level roads also lead to the Aberg and St. Leonhard, one of the most beautiful of which is the Katharinenweg. The Aberg with its newly erected outlook tower and café has become one of the most favourite excursions. It can be easily reached from the valley in an hour and a half, and on the magnificient new forest path in about three-quarter of an hour. The outlook tower offers an extensive view of the surrounding country. One overlooks the picturesque valley of the Tepl, Schloß Ziegelhütten and the Eger valley, in the distance the crests of the Erz-mountains with the Peindlberg and the Keilberg, whose outlook-towers can also be well recognised, as well as the heights and valleys lying in front of the Erz-mountains, above which the Saxon Fichtelberg towers up as an isolated

mountain cone. About fifteen minutes distant from the Aberg and lower down lies the St. Leonhard Restaurant situated on a picturesque opening in the woods. The Aberg as well as St. Leonhard can also be reached conveniently by carriages from the Wildpark Station (Aich-Pirkenhammer) of the Marienbad Railway in twenty minutes. The road leads from the railway station directly into the woods. This gently ascending road passes the Jägerhaus, a favorite terminus for all, to whom walking is labourious. The Aberg or St. Leonhard can also be reached by the Bildweg via the Bild, or by the hardly less attractive Queen Carolaweg. We also recommend the Archduchess Maria Sophienweg and the Belvedereweg as beautiful promenades.

To commemorate the visit of the Empress Elisabeth a road has been laid out through the woods, which leads from Aberg, where Her Majesty often loved to linger, to the valley of the Tepl, jointing the Marienbaderstraße below Pirkenhammer. At the spot, where this road turns in towards the Tepl valley, one gets a beautiful view of both the Tepl and Eger valleys, which are separated by high hills. The Faulenzerweg leads in the same direction from the valley. It is generally entered in the opposite direction from the Kaiserpark, the café situated in the valley, which is patronised as a rendezvous by the visitors. It was so called on account of its gentle ascent, which is an easy one even for the lazy, and it leads along a level defile in the woods to the Ecce Homo Chapel, Franz Josephs Height and the Jägerhaus.

The walks along the right bank of the Tepl are hardly less attractive. The ascent is rendered very easy by the cable tramway, which begins at Hotel Goldener Schild and leads to Helenenhof, Bismarcks residence in Carlsbad. One obtains a splendid panorama. A magnificent panorama presents itself a few steps along the carriage drive from the upper station

towards the National School: In the valley below the town and in the back-ground the heights on the left bank of the Tepl with their interposing hillocks and rocks, which force the river into its zigzag course. In the far distance lie the Erz-mountains, which are partly hidden by the masses of the Dreikreuz-mountains. One also gets this fine view from the Wiener Sitz, when the trees have shed their foliage. From this point of view lead a few more, though steep, paths through the woods to the Stephanie out-look tower, from which one enjoys an extensive view as far as the Marienbad district, from the ruins of Engelhaus and those of Hartenstein near Buchau to the Eger valley, as far as the Gießhübl Sauerbrunn and the Erz-mountains. Good walkers ascend or descend the Stephanie tower by the Dreikreuzberg, König Otto Höhe, and the Graf Thun Weg. Unfortunately these beautiful spots are on the whole far too little known to the visitors.

The highest point in the belt of woods surrounding Carlsbad is the Veitsberg (639 *m* above sea-level), situated in the so-called Plobenrevier, which affords a beautiful view across the high plateau, on which the villages of Espenthor and Schneidmühle lie. The visitor who desires to make an excursion to the Veitsberg, reaches it most conveniently by the Bismarckweg, which, beginning at the café Park Schönbrunn, leads through a gorge in the thick woods. This road is one of the most beautiful in the Carlsbad woods and leads to the Taxisbank, from which a circular panorama opens out. We see at our feet the Posthof with its extensive meadows in the background, the Vierruhrweg and Franz Josephs Height, apparently an offshoot of the Erz-mountains. In the Tepl valley to the left the Kaiserpark is visible, while on the right we have a wonderful scene, the town in the valley and the town on the heights, the one separated from the other as it were by a mass of rock. From Bismarckweg lead

communication-roads, among them the Freiherr von Gautschweg to the Nikolaus Dumbaweg in the direction of the Kaiserpark.

Most visitors to Carlsbad are doomed to take their walks in the valley. Still it cannot be said that they thereby miss the beauties of the landscape. On the contrary, the Goetheweg, the Posthofpromenade, with its everchanging panorama, are most beautiful walks; yet they are naturally very noisy owing to the great number of visitors and the enormous traffic, which winds along the high road towards Marienbad. On this promenade are situated the cafés known as Sanssouci, Schweizerhof, Park Schönbrunn, Posthof, Freundschaftssaal and Kaiserpark, all of which attract their guests owing to the picturesque charm of their situation.

As other distant excursions we may mention first of all Hans Heiling, picturesquely situated in the Eger valley, with the petrified Wedding Group. This is quite a picturesque piece of rock lying opposite the bank of the Eger, from which the isolated mass known as the Wedding Group juts out in a straight line. Those, who connect this excursion with a visit to the old village of Elbogen, reaching it either by carriage or on foot from Hans Heiling, will be as much charmed by the beauty of this wonderful road, which leads along the Eger through the thick woods, as by the beauty of the town Elbogen itself, which is quite enclosed by the river. This town is noted for its numerous buildings, which date back to the middle ages, including the castle and the town-hall, and presents many not-worthy sights. A beautiful circular excursion can be made by carriage from Carlsbad to Elbogen, Hans Heiling, Aich, St. Leonhard, and back to Carlsbad.

The visitor who does not mind a two hours walk should not fail to visit the Hermanstein. This is a rock deeply situated in the woods between Engelhaus and the Gießhüblerstraße, which drops quite abruptly

towards the Eger. One enjoys from this point a magnificent circular view towards Engelhaus and Buchau, into the Eger valley, as far as Gießhübl Sauerbrunn, and in the direction of the Erz-mountains, towards which the plains of arable land gently slope in many terraces. At the foot of the rock a woodkeepers house affords simple refreshments. A passable road also leads into the woods at Hermannstein. This road branches off from the Gießhüblstraße behind the branch of the Soosbachtalstraße, and is known as the Emmaweg. The visitor who drives to Hermannstein should not fail to make the journey by the Emmaweg and the Soosbachtalstraße.

The spots made famous by their springs — Gießhübl Sauerbrunn and Krondorf — especially invite for longer excursions. The former can be reached by carriage in an hour and a quarter. There is also a regular omnibus service; traffic is also rendered easy by means of the local railway, which branches off at Wickwitz from the chief network of the Buschtehrad Railway.

We must also recommend an excursion to the Keilberg, the highest point in the Erz-mountains, as part of the programme of a sojourn in Carlsbad. From all the heights in Carlsbad one sees the towering out-look tower, which affords an extensive view towards Saxony and Bohemia. One goes by rail to the old mountain town of Joachimstal, which contains the only profitable mine of radium-bearing uranium. Thence by carriage or on foot we can reach the Keilberg, whose steep mountain slopes afford many sources of attraction to those who are fond of winter sports. An hotel in that place affords good lodging.

We might also refer to an excursion to the Peindlberg as being worth the trouble. It can be reached from the railway station of Neudeck. Its out-look tower affords a fine view in the direction of Carlsbad.

The new railway connection with Marienbad through the Tepl Valley and with Johann Georgenstadt in the Salm Valley and to Joachimstal opened up a tract of fine mountain landscapes, the impressions of which are only slightly inferior to those of many high mountain scenes. Everyone is quite satisfied with his visit.

CHAPTER VIII.

Winter Cure and Winter Residence.

The season closes so to speak on the last of September, although not officially. Even the most magnificient autumn and the most beautiful October days have not the power of deceiving one about the sudden passage from in-season to out-of-season, from Summer to Winter, more especially as a number of external circumstances cause winter to set in sooner than the climatic conditions would do. To these circumstances belong first of all the winter time-tables of the railways which insist too egoistically upon the economy of each carriage axis and of every seat. Otherwise they would, considering the extreme reduction in the number of trains, provide at least for a single direct connection in the main directions. The principal hotels and most of the bathing establishments are closed. The brilliant illumination of the town is diminished, while concerts and theatre are suddenly stopped, as if all at once the whole town felt need of rest after the exertions of the season.

Naturally the springs bubble up as in summer, and many a patient finds the peace and quiet of the promenades in the valley beneficial, in which the almost too abundant musical pleasures of the cafés now no longer pursue him. Still, the stay becomes not a very comfortable one.

The building activity which is forbidden during the season begins accompanied by the heavy traffic in the streets, which then assume quite a different character. In spite of all this we may say that the use of the cure in a u t u m n and the e a r l y p a r t of the year still possesses sufficient charms, which, are

increased by the fact that the intercourse of the visitors is rendered more easy due to the diminished number of rendezvous. Nevertheless the use of the cure in the severe winter season is only to be recommended, if it cannot be postponed, or if professional business absolutely does not permit of any other arrangement. For the winter is usually long and severe. There are a few centrally heated hotels and the bathing establishment in the Kurhaus is opened in the winter. If, however, the baths form an integral part of the cure, and in most cases this is so, then in consequence of the difference in temperature of the atmosphere and of the baths the risk of catching cold is greatly increased.

During persistently bad weather the patients do not know what to do with their time, and are either confined to their rooms or are compelled to pay a visit to one of the few cafés which harmonise precisely in accordance with the winter management, with the general conditions of things. Winter residence is also to be less recommended to the patient who, having the time and opportunity, is able to carry out his drink and bath cure in a season prolonged into autumn and the early part of the spring. For those, however, who cannot postpone the cure at Carlsbad, the winter conditions are of no consequence and they learn how to get on in winter. They find all the necessary remedies at their disposal. They receive the greatest of all attention. All that is lacking are sunshine and a mild climate. To lovers of winter sport, however, there is abundant opportunity of enjoying it. A comfortable and specially constructed toboggan run, which stretches from the Holzplatz as far Klein-Versailles, permits of tobogganing free from all risk. A small skating place at Klein-Versailles and a similar one on the ponds in Fischern attract people to skate. For all kinds of winter sport, and especially for skiing, the neighbouring Erz-mountains, and chiefly the Keilberg, have lately become a veritable Mecca,

to which on Sundays many hundreds desirous of sport journey from Saxony and Bohemia.

A pleasant break in the monotony of the winter remains for us in the future, since our theatre will from this year on open its hitherto closed doors also in winter.

CHAPTER IX.

The Water Export and Spring Products.

The sanctuary of the inhabitants of Carlsbad, namely their springs, which have formed for centuries the base of their existence, was always well guarded by them, so much so that they refused to allow the water to be exported. When in the beginning of the eighteenth century Hoffmann of Halle propagated the idea, that we could take the Carlsbad cure outside of Carlsbad by means of the Carlsbad waters, and supported this theory by quoting the names of the patients, who had used the waters with equal effect as in Carlsbad, the community was in evident uproar, and did not rest, until they had found out the "Water Smuggler", who suffered a severe punishment. In consequence of the numerous representations made by the governors and at Court, which arose from the fear that no one would come to take the cure at Carlsbad, if the waters were exported, whereby the population would be ruined, the town of Carlsbad declared that the drawing off and export of the Carlsbad waters would be punished with the most severe penalty and that the export of water out of Carlsbad would only be permitted by Royal Consent in exceptional cases to individual personalities.

In 1831 Professor Bischoff of Vienna, incidentally to his residence at Carlsbad, instigated the exportation of the Carlsbad water.

In view of an opinion of the Medical Faculty at Prague this was refused to the great delight and consolation of the Community, since the Faculty regarded the use of the Carlsbad water only as "solely genuine and real" at the springs themselves.

At the time the watering-places of Franzensbad and Marienbad had already commenced the export of their mineral waters with good results, and without

suffering a loss in the number of visitors. This circumstance was made use of by Professor Pleischl of Vienna, who for years had advocated with warm interest the export of the Carlsbad water, and he published an article on this subject in the "Austrian Medical Journal". Pleischl referred in eloquent terms to the example of Marienbad and Franzensbad. He advocated the view that Carlsbad could only profit by doing so, as everybody would carry out the cure properly at the spot after first trying it with the exported water. Through this publication (1842) the question became an important one, and it led to the endeavours of Dr. Hlawaczek and of Dr. v. Hochberger, the Royal physicians at the springs, to obtain the consent of the Government for the specially decreed permission of the springs Commissioners to export the water (October 1842). Experiments were first of all made with the exported water at the large hospitals in Vienna, Prague and Lemberg. Expert opinion was heard as to whether the water was altered by transport. When it was reported and demonstrated that the thermal water remained unchanged by transport, the export of the water was actually begun in the year 1843, and a concession for the export was given to Joseph August Hecht for 1500 florins per annum, although a Carlsbad firm had made a more favourable offer. He carried on a similar business in Franzensbad and enjoyed the special favour of the Prefect of the district at that time. The lease lasted for three years. The lease of the mineral waters also led to the question as to the ownership of the springs, and as to whether the owner of the land, out of which they rose, had a right to the export or to compensation. — Dr. v. Hochberger had striven with genuine patriotic zeal, and under the exercise of his important personal influence, for a decision favourable to the municipality; and he succeeded in obtaining a Royal Resolution in the year 1846, according to which the exclusive property and profit rights in the wells belonged

solely to the municipality of Carlsbad. For this the town of Carlsbad accords to his memory everlasting thankfulness.

The lessee of the mineral water export had in the first year a great success and a large sale. He exported also in the second year over 100.000 flagons. The export did not do influence the frequency of the watering-place in the least degree. On the contrary, it was increased, as intelligent people had prophesied. The population were satisfied with the fact, and very soon discovered that this kind of profit from the springs was actually for them a source of greater revenue and a means of reducing their taxes. Professor Pleischl was reinstated with honour. In 1846 the export of the water was leased to the Carlsbad citizens Damm and Seifert for six years, for the sum of 6637 florins per annum. These brought the trade to the highest point by means of commercial travellers. But owing to the revolution year and the many various obstacles placed in their way they got into difficulties, which led to the lease being forcibly broken on the part of the lessees. Then followed the darkest chapter in history of this enterprise, when in the year 1850 the municipality took the management into their own hands. Whereas in both preceding periods much stress was laid on the advertisements of the waters in the newspapers, and much money was expended for that purpose, this was now suddenly abandoned and the expense of insertions in the newspapers was no longer tolerated. This was perhaps due to meanness, perhaps to scarcity of money, perhaps also to the presumptious idea that the business already acquired did not require such advertising. The export fell off constantly, and after seven years of their management the mineral water export was again leased out. — Heinrich Mattoni and Friedrich Knoll acquired the lease in the year 1857 for the annual sum of 7050 florins. The former unceasingly endeavoured to extend the business and succeeded, with

the far-seeing eye and the circumspection of an experienced merchant, in developing the business to such an extent, that at the end of the tenth year of the lease the export exceeded 350.000 flagons. When he then, relying on his experience and trusting to the development of the business, offered nearly double the sum, 14.000 florins, as lease for the new ten years period, his partner Knoll withdrew from the business as being too risky. And now we notice a rapid progression, not only of the number of the flagons, but also in the amount of the rental. The increase of the sale led to the decision of the municipality to dispose of the new lease in the year 1876 only by public tender. A new competitor entered the field, the firm of Löbel Schottländer with an offer of 70.000 florins. After Mattoni, whose untiring work in the flourishing condition of the water export became universally acknowledged, could not be persuaded to raise his offer from about 50.000 florins per annum to about 57.000 florins, the firm of Schottländer obtained the lease and assured it for themselves during the next two periods of fifteen years at the enormous rental of 175.000 florins and 560.000 Kronen respectively. The export of bottles in the year 1901, when the lease was renewed for the last time, amounted to 3,000.000. Exactly in the same way as the export of the waters the number of visitors to the health-resort has increased. This to-day already amounts to over 62.000 persons annually. Naturally the most minute rules on the part of all interested circles are observed by the firm of Löbel Schottländer as well as by the town and public control department in connection with the filling and export of the mineral water which is delivered in one litre bottles. Berzelius of Stockholm at the commencement of the forties confirmed the fact that the water sent ower to him for chemical analysis remained absolutely unchanged, a fact which was endorsed by the later investigations of such men as Redtenbacher and Pleischl, and as far as r o u g h chemical proof goes this will certainly also be the case to-day.

The Spring Products.

The sprudel salt has the most prominent position among the products of the springs which are obtained from the Carlsbad mineral water. This salt is obtained by manufacture in a large work known as the sprudel salt works. The production now amounts to nearly 100.000 kg. It has experienced many changes. The first note we have on the Carlsbad salt is found in the beginning of the seventeenth century, where the "warm bath salt" is valued as a subsidiary aid to the drink cure. In the year 1718 the export and manufacture of the salt was forbidden together with the export of the water. It appears, however, that this prohibition was not observed with such strictness as in the case of the mineral water, for in the year 1735, 115 pounds of the Carlsbad salt were sold. The fear of the community lest the consumption of the salts should diminish the number of visitors to the baths, led also in this case to restrictions. The circumstance, however, that other mineral salts under the false name of Carlsbad salts, which on account of the reputation of the town, were readily bought by the public, led to Empress Maria Theresia in the year 1764 giving her sanction to the extraction of the salt according to the method of Dr. David Becher. The latter was one of the meritorious men in Carlsbad in former days, and his mode of extraction depended on the fact that the temperature of the sprudel itself replaced the heat of a fire. A copper kettle filled with sprudel water and lined inside with tin was placed in a large reservoir with a constant inflow and outflow of sprudel water. Its contents were subjected to evaporation by the surrounding hot water baths; the weak salt lye thus obtained after twenty-four hours was collected in several kettles without the earth which was removed, and again and again subjected to the evaporating process. After the evaporating process had lasted for a few days the heavy salt lye

was poured into flat vessels, and set in a cool place, upon which beautiful white crystals appeared. The increased salt consumption disturbed the people of Carlsbad very much; still their objection was met upon reference to the increased number of persons coming for the cure. The number of kettles for the extraction of the salt had always to be increased. On account of the limited space at the Sprudel in the year 1832 the preparation of the salt was forbidden during the season from 15th May to 15th September. In order to meet the increased demand for the sprudel salt, which had arisen especially since the beginning of the export of the mineral water, Dr. Hlawaczek proposed to produce a second salt. The apothecary Göttl made the suggestion that the manifold crystallisation as carried out by Becher should be given up. This proposal did not meet with the approval of the authorities of the town. In the year 1867, however, a proper establishment for the extraction of the salt was established, the old evaporating apparatus of Becher was broken up and an end made of the evaporating process in furnaces. Later the sprudel water was led by a pipe into large evaporating pans with fires underneath and the concentrated lye obtained in this way was poured out into casks for crystallisation, and the collected crystalls again re-crystallised. As the amount of the sprudel salt so obtained did not meet the demands a new evaporating establishment was erected at the end of 1870, according to the plans of the engineer Dr. Adolf Frank of Charlottenburg. Subsequently it was shown that the composition of the sprudel salt was variable, and did not correspond to the values obtained by Ragski in the year 1862. The analysis of Ragski was as follows:

Sodium Sulphate	37,695 %
Sodium Chloride	0,397 %
Sodium Carbonate	5,997 %
Potassium Sulphate. . . .	traces
water of Crystallisation . .	55,520 %

This analysis became, according to the proposal of Prof. E. Ludwig of Vienna, who subsequently carried out investigations on the spring and spring products of Carlsbad, a permanent basis for the composition of the crystallised sprudel salts; and the crystallised salt since that time was all delivered under strict control in accordance with this composition. — Moreover the Carlsbad salt in powder form was still produced. This contained all the soluble ingredients of the sprudel water. The form of the salt in powder is much more constant and is specially suited for export to distant parts. Its production since 1882 has been carried out in accordance with the directions of Prof. E. Ludwig in such a way, that the concentrated and filtered sprudel is completely evaporated and the dry product is exposed to the free carbonic acid gas leaving the sprudel water in order to take up once more the decomposed bicarbonate. The product thus saturated with carbonic acid gas is then finely ground down and poured out into glasses. It contains all the ingredients of the sprudel water in similar chemical combination. Its composition is, according to the original analyses made by E. Ludwig in the year 1900, as follows:

Lithium Carbonate	0,20 %
Sodium Bicarbonate	36,11 %
Potassium Sulphate	3,31 %
Sodium Sulphate	41,62 %
Sodium Chloride	18,19 %
Sodium Fluoride	traces
Sodium Biborate	0,03 %
Silicic Ahydride	?
Iron Oxyde, Lime and Magnesia	traces
Water	0,44 %

In consequence of continued building and machinery extensions and improvements the sprudel salt works in their modern state have become an object of great interest in Carlsbad. The hot cauldrons, which are

used in place of the kettles are now so large, that it is possible to evaporate 100 litres of sprudel water per minute. The consumption in the year 1835 reached 310 kilograms and rose constantly up to 1901 when it reached 76,035 kilograms.

With the increase of consumption we observe the same relations, which exist between the export of the water and the frequency at the health resort.

Compared with the sprudel salt the other spring products are of secondary importance. These are the sprudel lye and the sprudel lye-salt. Both products are obtained from the residue left in the preparation of the crystallised Carlsbad sprudel salt, and are chiefly of service as additions to the baths. The lye-salt comes into the market in packets of one kilogram, while the lye itself is in litre bottles. All the remaining products bearing the mark of the sprudel and connected with the Carlsbad springs are not natural but artificial products, such as the sprudel pastilles, sprudel soap etc. Attempts have been repeatedly made by various firms by means of uncontrolled additions to the salt, to set up new relations with the Carlsbad hot springs. These attempts, however, were nipped in the bud in order to prevent the public from being deluded, and thus the conditions of the actual Carlsbad spring products has so far been preserved unadulterated.

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